2.3.1 Upstream Snake River Segment (RM 409 to 335):

The Upstream Snake River segment (RM 409 to 335) includes the riverine section of the Snake River upstream of the Hells Canyon Complex (Figure 2.3.2). It extends from where the river intersects the Oregon/Idaho border (near Adrian, Oregon) downstream to Farewell Bend. All of the major tributary inflows to the SR-HC TMDL reach (with the exception of the Burnt and Powder rivers) enter the mainstem river within this segment. The vast majority of agricultural and urban/suburban land use within the SR-HC TMDL reach occurs within this segment. Flow within this segment is primarily driven by snowmelt and seasonal precipitation events, upstream and tributary impoundments, and irrigation diversions and returns. Because of the significant role flow plays in water quality issues in the SR-HC TMDL reach, a brief discussion of specific flow characteristics has been included below for each of the tributaries into the Upstream Snake River segment (RM 409 to 335).

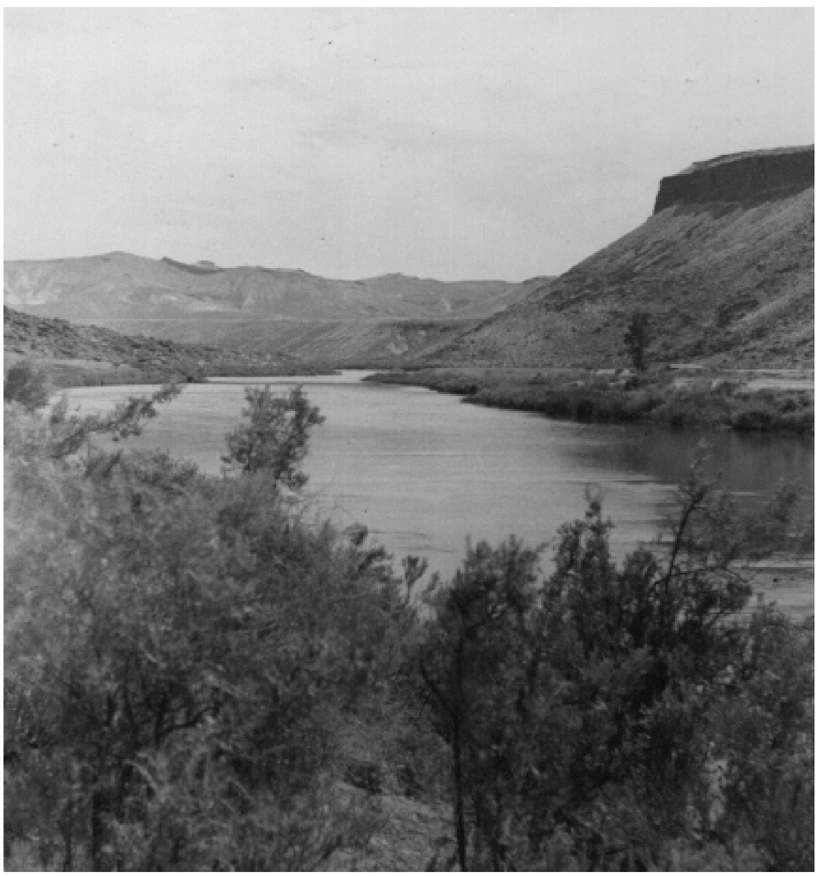

Photo 2.3.1. The mainstem Snake River near Murphy, Idaho (near RM 453.5) circa 1939-40, relatively low water years. Photo from the collection of Dr. Lyle M. Stanford.

2.3.1.1 INTRODUCTION

The tributary inflows to the SR-HC TMDL reach include the Snake River upstream of the SR-HC TMDL reach (inflowing at RM 409), which contributes approximately 52.7 percent of the

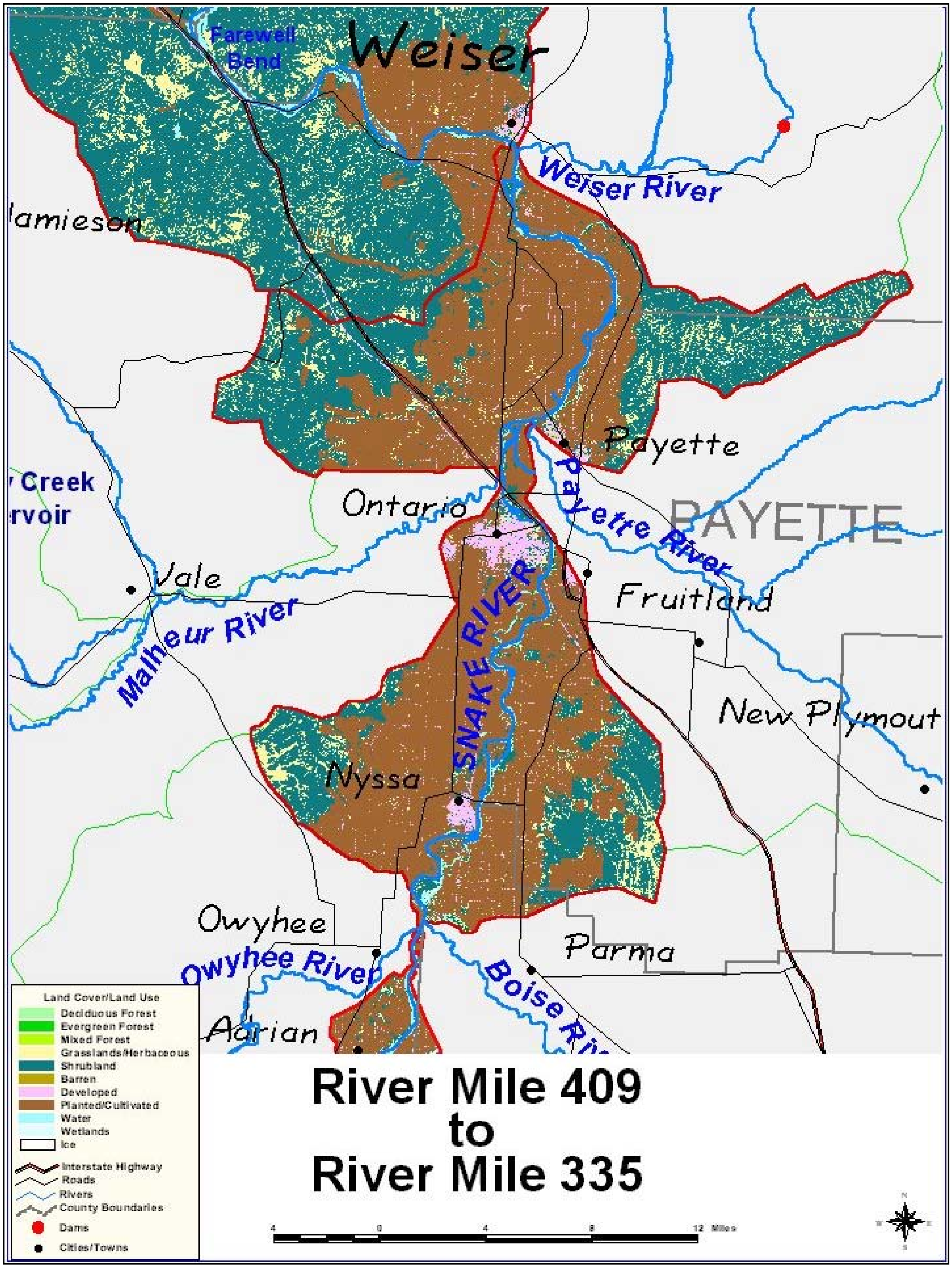

Figure 2.3.2 Upstream Snake River segment of the Snake River – Hells Canyon TMDL.

relative average annual inflow to the SR-HC TMDL reach and drains approximately 42,800 square miles of land in southern Idaho. Segments of the Snake River above the SR-HC TMDL reach are listed for nutrients, pesticides, mercury, temperature and sediment. The Mid-Snake River segment (RM 638.7 to RM 544.7) has an approved TMDL in place and is currently in the implementation process for reductions in phosphorus (IDEQ, 1997c). Using the total inflow to Brownlee Reservoir as calculated from the average annual outflow of 16,191 cfs, the tributary flows can be ranked by relative average annual inflow as follows: the upstream Snake River (52.7 %), the Payette River (17.9 %), the Boise River (9.2 %), the Weiser River (5.2 %), the Owyhee River (2.7 %), the Malheur River (2.2 %), the Powder River (1.2 %) and the Burnt River (0.8 %). These inflowing tributaries routinely exhibit highly variable annual flows (Table 2.1.1). Ungaged flows make up approximately 8.1 percent of the total flow volume.

Due to flood control and storage management upstream, overall flow patterns within the mainstem Snake River as it enters the Upstream Snake River segment (at RM 409) of the SR-HC TMDL reach are less variable than some of the other inflowing tributaries. However, the reach does experience seasonal variation in flow patterns. Flows within the Snake River in this area are commonly higher during spring runoff (usually extending from late February to early June) when mountain snows melt and spring rains increase tributary flows. Irrigation diversions in the major tributaries and dryer summer weather patterns substantially reduce summer and fall flows. These flows are not usually less than 50 percent of those observed during the spring season however. As shown in Figure 2.3.3, mean annual flows vary from an average of 15,000 cfs during spring runoff to an average of 8,000 cfs during the summer season (annual averages compiled from 1980 to 1999 USGS flow data from the gauge near Murphy, Idaho #13290450).

Owyhee River.

The Owyhee River (inflow at RM 396.7) represents 2.7 percent of the relative average annual inflow to the SR-HC TMDL reach and drains approximately 11,160 square miles of land in southeastern Oregon, southwestern Idaho and northern Nevada. Land use is primarily agricultural, with grazing being the predominant practice. Limited areas of irrigated agriculture are present along the river and its tributaries (IDEQ, 1993b).

A TMDL for the lower Owyhee River in Oregon targeting pesticides, mercury, temperature, bacteria and chlorophyll *a* is scheduled for 2006. TMDLs for the Middle, North and South Fork Owyhee River in Idaho targeting temperature have recently been completed and approved by US EPA (IDEQ, 1999c and 2000a).

Flow patterns within the Owyhee drainage are seasonal in nature; increasing during spring runoff (usually extending from late February to early April) when mountain snows melt and spring rains increase secondary tributary flows. Irrigation needs and dryer summer weather patterns substantially reduce summer and fall flows. These flows are often less than 7 percent of those observed during the spring melt.

The operation of the Owyhee Reservoir (1932, 715,000 acre-feet active capacity) and Wildhorse Reservoir on the East Fork Owyhee (in Nevada) reduce total flow variability and localize sedimentation within the reservoir systems. The reservoirs are operated primarily for irrigation storage but also for flood control and recreation. Owyhee Reservoir is also operated for hydropower generation.

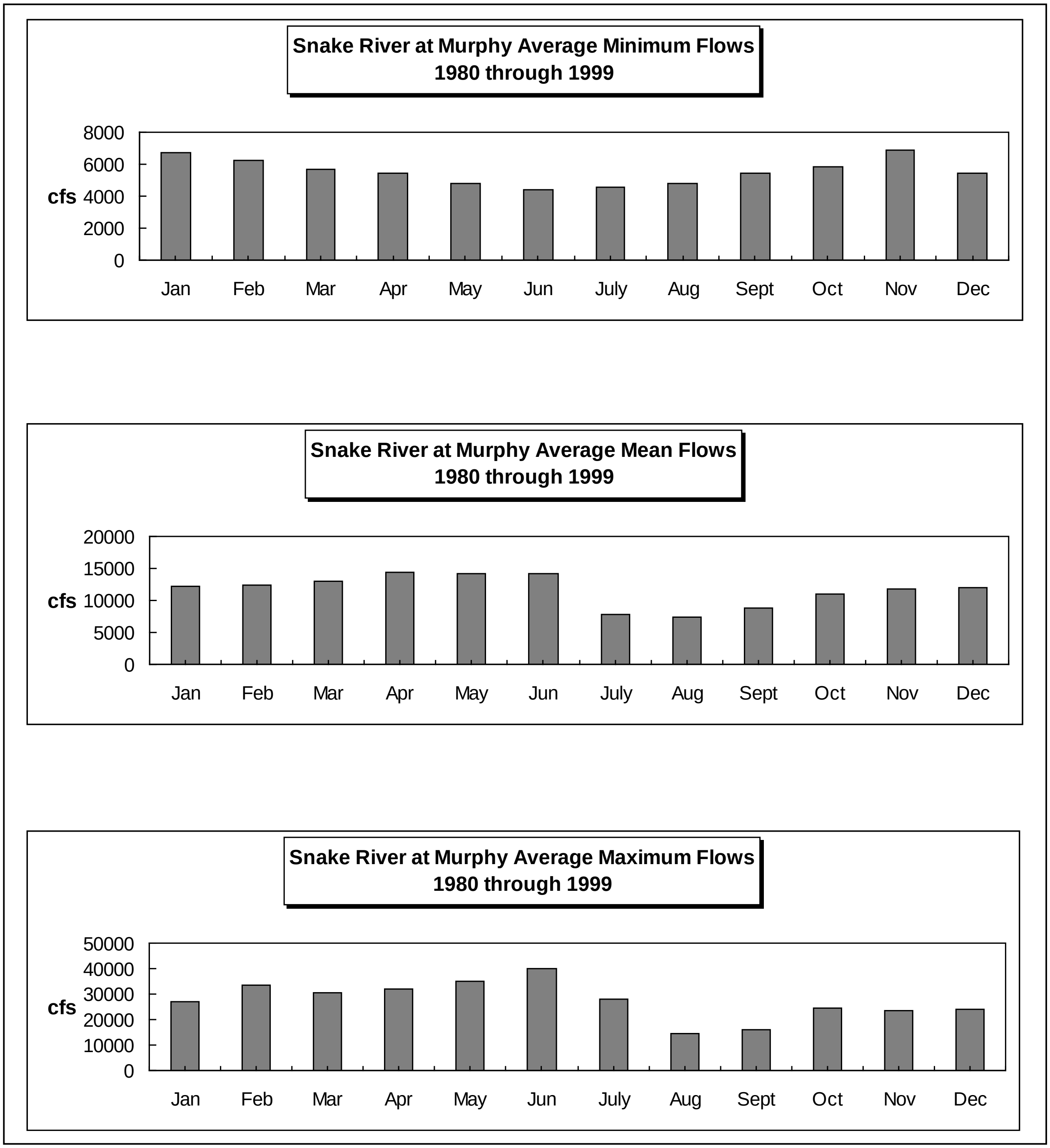

Figure 2.3.3 Minimum, mean and maximum flows observed in the mainstem Snake River (near Murphy, Idaho, RM 453.5).

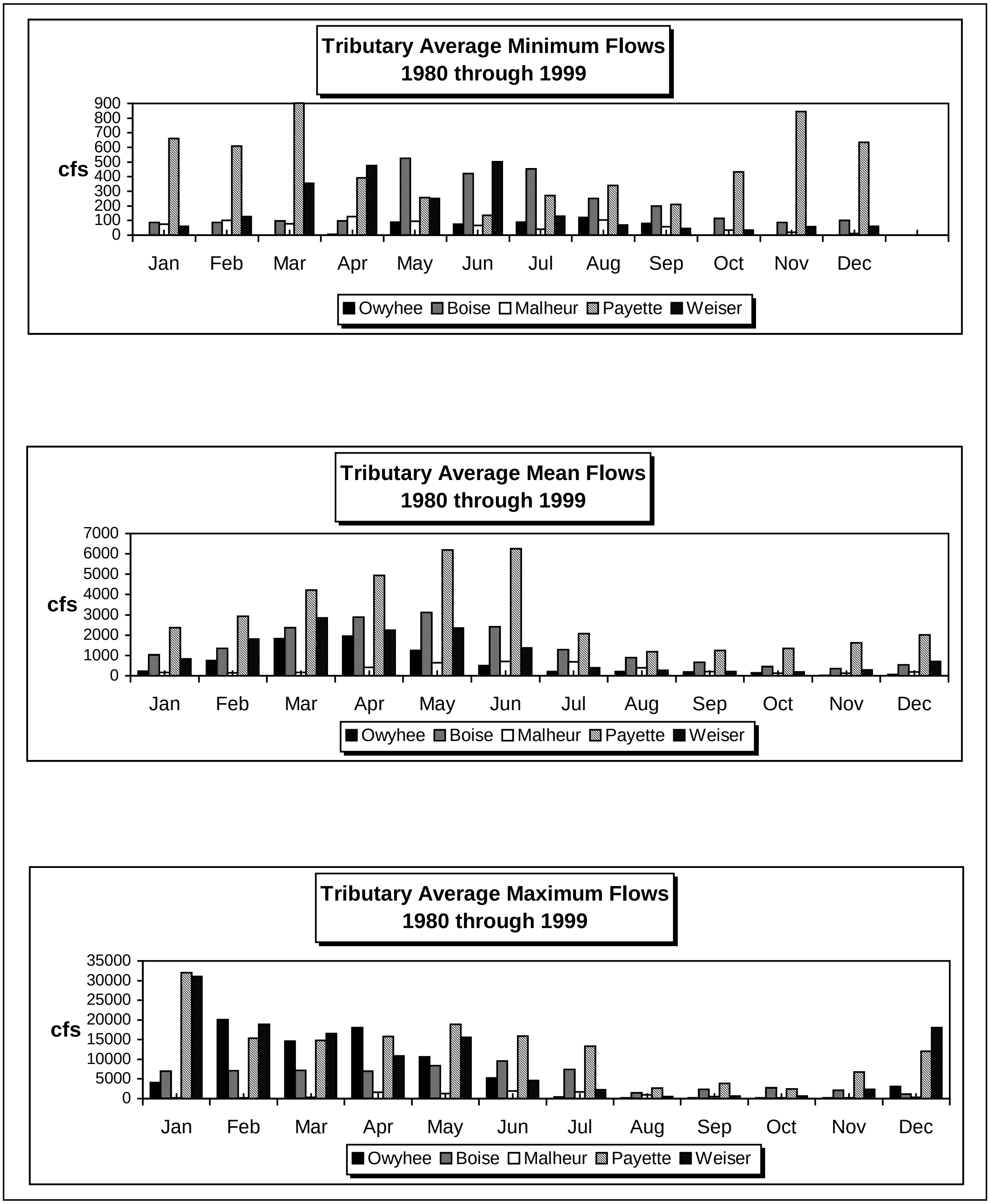

Figure 2.3.4 Minimum, mean and maximum flows for tributaries to the Upstream Snake River segment (RM 409 to 335) of the Snake River - Hells Canyon TMDL reach.

As shown in Figure 2.3.4, average mean flows vary from 2,900 cfs during spring runoff (April) to an average of 140 cfs during the late summer season (September) (annual averages compiled from 1980 to 1999 USGS flow data from the gauge near Rome Oregon, #13181000) and total flows at the mouth as calculated by the USBR (USBR, 2001).

Boise River.

The Boise River (inflow at RM 396.4) contributes approximately 9.2 percent of the relative average annual inflow into the SR-HC TMDL reach and drains 3,970 square miles of land in southwestern Idaho. The Boise River watershed contains two sections, distinct in characteristics and flow. Dams dominate flow in the upper watershed and land use is primarily forestry (public lands), rangeland, recreation and mining activities. The reservoirs in the upper watershed have a substantial influence on the flow patterns in the lower watershed. The lower watershed contains no major impoundments. Land use in the lower Boise River drainage area is predominantly agricultural, but is becoming more urbanized with the recent growth in population in the Boise area. The Boise River drainage contains several major urban areas including the City of Boise, the largest population center in the SR-HC watershed, containing over 32 percent of the total population of the State of Idaho (US Census estimates for 1997).

A TMDL addressing sediment and bacteria issues in the Lower Boise River was approved in 2000 (IDEQ, 1998a). Nutrient reductions in the lower Boise River TMDL were deferred to correlate with the completion of the SR-HC nutrient TMDL. Load and waste load allocations for Lower Boise River nutrient sources specific to downstream impacts will be identified by the Lower Boise River TMDL process.

Flow and velocity within the Boise River drainage are seasonal in nature. High flow volumes and velocities are commonly observed during spring runoff conditions (late February to early April), when warmer temperatures and spring rains result in rapid snowmelt and increased tributary flows. Dry, hot summer conditions, in combination with the fact that significant landmass in the drainage (over 200,000 acres) is under irrigation result in lower summer and fall flows. These flows are often less than 10 percent of those observed during the spring melt. However, while total flow volumes decrease after the spring melt, these irrigation practices act to increase average minimum stream flows in the Lower Boise River throughout May, June, July, August and September. Flows generally taper off through October and November, with annual average minimum flows occurring during the winter months (November through January).

The operation of three impoundments, Lucky Peak Reservoir (1957, 264,400 acre-feet active capacity), Arrowrock Reservoir (1915, 286,600 acre-feet active capacity) and Anderson Ranch Reservoir (1950, 423,200 acre-feet active capacity) act to reduce the total flow variability and localize sedimentation within the reservoir systems. All three reservoirs are operated for flood control and irrigation storage. In addition, Lucky Peak and Arrowrock Reservoirs are operated for hydropower generation. Although recreation and the associated facilities are important to all three reservoirs, only Arrowrock Reservoir is specifically designated as being operated for recreation.

As shown in Figure 2.3.4, mean flows vary from a monthly average mean of 3,100 cfs during spring runoff (May) to a monthly average of 800 cfs during the late summer season (August) (annual flow data compiled from 1974 to 1999 USGS flow data from the gauge located near Parma, Idaho, #13213000). This reach also contains the Sand Hollow Creek drainage.

Malheur River.
The Malheur River (inflow at RM 368.5) contributes approximately 2.2 percent of the relative average annual inflow into the SR-HC TMDL reach and drains 3,900 square miles of land in southeastern Oregon. Land use in the lower Malheur drainage is predominantly agricultural (grazing and row crops), and contains the City of Ontario (IDEQ, 1993b). Flood irrigation is more commonly utilized in the upper Malheur River system than furrow irrigation.

A TMDL targeting bacteria, chlorophyll *a* and pesticides is scheduled for 2003 by the State of Oregon.

Flow within the Malheur River follows seasonal patterns with high flows in the upper watershed during the spring (March to April) due to spring rains and snow melt, however these high spring flows usually do not occur in the lower watershed because of reservoir filling which acts to hold the water in the upper reaches. Low flows occur in the lower reaches during the late summer and fall seasons as a result of agricultural diversion. Low flows usually average less than 40 percent of high spring flows.

The operation of four impoundments, Bully Creek Reservoir (1964, 30,000 acre-feet active capacity), Beulah Reservoir (1935, 59,900 acre-feet active capacity), Warm Springs Reservoir (1919, 191,000 acre-feet active capacity), and Malheur Reservoir (1912, original capacity was 38,000 acre-feet; current capacity is 21,000 acre-feet due to safety restrictions on the upper portion of the dam), act to reduce the total flow variability and localize sedimentation within the reservoir systems. The reservoirs are operated primarily for irrigation storage. Bully Creek Reservoir is also operated for flood control, recreation and fish and wildlife uses.

As shown in Figure 2.3.4, average mean flows in the lower reaches vary from 500 cfs during spring runoff when reservoirs are filling, to an average of 700 cfs during the summer irrigation season (annual averages compiled from 1980 to 1999 USGS flow data from the gauge located near Vale, Oregon, #13233300, approximately 20 miles upstream of the mouth of the river.) Warm (geothermal) springs are prevalent in the Malheur River drainage and may act to influence water temperatures in localized areas.

Payette River.
The Payette River (inflow at RM 365.6) contributes approximately 17.9 percent of the relative average annual inflow to the SR-HC TMDL reach and drains approximately 3,240 square miles of land in southwestern Idaho. Land use in the Payette River drainage is predominantly agricultural and forestry. Forested land is primarily located in the upper portion of the Payette River drainage, with the majority of agricultural and urban areas located in the lower portion of the river basin (IDEQ, 1993b).

A TMDL addressing bacteria in the Lower Payette River was approved in 2000 (IDEQ, 1999b). Nutrient reductions for the Lower Payette River drainage were deferred to correlate with the completion of the SR-HC nutrient TMDL. Load and waste load allocations for the Lower

Payette River nutrients specific to downstream impacts will be identified by the Lower Payette River TMDL process.

Flow and velocity tend to increase during spring runoff, usually occurring between late February and early April, when mountain snows melt and spring rains increase secondary tributary flows. Irrigation needs and dry summer weather patterns significantly reduce summer and fall flows. These flows are often less than 30 percent of those observed during the spring melt.

The operation of Black Canyon Dam (1924, a diversion facility), Deadwood Reservoir (1933, 161,000 acre-feet active capacity) and Cascade Dam (1947, 653,200 acre-feet active capacity), act to reduce the total flow variability and localize sedimentation within the reservoir systems. Black Canyon Reservoir is largely filled with bedload sediment and no longer represents a substantial storage capacity. The reservoirs are operated for irrigation storage and hydropower generation. In addition, Cascade Dam is operated for flood control, and Deadwood and Black Canyon reservoirs are operated for recreation.

As shown in Figure 2.3.4, average mean flows vary from 6,200 cfs during spring runoff to 1,700 cfs during the summer season (annual averages compiled from 1980 to 1999 USGS flow data from the gauge located near Payette, Idaho, #13251000, relatively close to the mouth of the river.)

Weiser River.
The Weiser River (inflow at RM 351.6) represents approximately 5.2 percent of total system flow and drains over 1,455 square miles of land in the southwestern Idaho. Land use is predominantly agricultural with grazing and cropping being the most common practices in the drainage. Forested land is primarily located in the upper portion of the river drainage. The proportion of agricultural and urban use increases near the inflow of the Weiser to the Snake River (IDEQ, 1993b; IDEQ, 1985).

A TMDL addressing bacteria, dissolved oxygen, nutrients, sediment and temperature in the Weiser is scheduled for 2003 by the State of Idaho. Nutrient reductions for the Weiser River TMDL will include nutrient load allocations from the approved SR-HC nutrient TMDL.

Flows within the Weiser River drainage exhibit substantial seasonality with annual high flows commonly occurring during the spring (March to April) due to snow melt and spring rain, and low flows occurring during the late summer and fall seasons as a result of agricultural diversion. Low flows usually average approximately 20 percent of high spring flows. While the only large impoundments in the Weiser River are located high in the drainage, irrigation water management results in significant alteration of historical flows.

As shown in Figure 2.3.4, average mean flows vary from 2,700 cfs during spring runoff to an average of 300 cfs during the fall season (annual averages compiled from 1980 to 1999 USGS flow data from the gauge located near Weiser, Idaho, #13266000, relatively close to the mouth of the river.)

Hydrology within the tributary drainages to the Upstream Snake River segment (RM 409 to 335) is extremely complex. All of the major tributary watersheds contain agricultural lands. Irrigation water use within these drainages is often highly complex in nature. In many cases, water is diverted onto fields and pasturelands, discharged back into the tributary streams through irrigation drains and subsurface flows, and is then re-diverted onto lands downstream. Additionally, water is also diverted from one tributary and then discharged through irrigation drains into a separate watershed entirely. Site or discharge-specific tracking of pollutant loading is therefore equally complex and highly dependent on precipitation and flow levels, as well as seasonal timing and irrigation usage.

Photo 2.3.2. The mainstem Snake River near Weiser, Idaho (near RM 351) circa 1939 to 1940, relatively low water years. Photo from the collection of Dr. Lyle M. Stanford.

It is expected that some reductions in loading in highly enriched nutrient and sediment-laden waters occur as irrigation flows move through tributary systems and are diverted onto fields and pastures with growing vegetation and low velocity water movement. However, in other areas where diverted waters initially contain relatively low concentrations of nutrients and sediment, the potential for enrichment increases as the water moves downstream within the tributary drainage and is repeatedly diverted. These system complexities have been taken into account to the extent possible in the loading assessment, and will be addressed in the implementation plan for the SR-HC TMDL, and in the distribution of load allocations within the tributary drainages.

2.3.1.2 Water Quality Concerns/Status

General Information

The waters of the Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach are listed as water quality limited for bacteria, dissolved oxygen (RM 409 to 396.4 only), mercury, nutrients, pH, sediment, and temperature as outlined in Table 2.3.1.

A detailed examination of the data available to this assessment has identified two of these pollutants (bacteria and pH), which do not seem to be serious water quality issues in this segment at this time (see detailed discussions below). The rest of the pollutants appear, from the existing data to be limiting the attainment of the designated beneficial use support in this segment. Each of the pollutants and its potential impact on this segment of the SR-HC TMDL reach is described in more detail in the following sections.

Listed Pollutants and Designated Beneficial Uses

Table 2.3.1 summarizes the listed pollutants and designated beneficial uses for the Upstream Snake River segment (RM 409 to 335). A more detailed description of each of the designated beneficial uses is included in the Designated Beneficial Uses section (Section 2.2.2). A more detailed description of the listed pollutants and the assessment process is located in Sections 3.0 through 3.7.

Salmonid spawning within these drainage basins is most likely to occur within the tributaries to the SR-HC TMDL reach where flow and substrate conditions are favorable to support such uses. Therefore, the salmonid spawning beneficial use designation and its accompanying water quality targets will apply to those tributaries so designated. As these tributaries are not interstate waters, and salmonid spawning use support is a localized habitat issue, state-specific targets for salmonid spawning will apply to those areas of the tributaries designated for salmonid spawning.

As outlined in Table 2.3.1, salmonid rearing as well as resident fish are included in the designated beneficial uses in this segment. The primary salmonid species in this segment are rainbow trout and mountain white fish. Resident fish include cool and warm water fish such as bass, crappie, and catfish. In addition there is a small population of white sturgeon at the lower end of this segment. A more complete listing of fish species by segment is located in Section 3.6.

Summary and Analysis of Existing Water Quality Data

Bacteria.

The Upstream Snake River segment (RM 409 to RM 335) is listed for bacteria. Additional, more detailed information on bacteria is included in Section 3.4.

<u>General Concerns</u>. Violations of the numeric criteria for bacteria (see Table 2.2.1) in surface waters can result in health risks to individuals using the water for primary contact recreation such

Table 2.3.1 Listing information for the Upstream Snake River segment of the Snake River - Hells Canyon TMDL reach (RM 409 to 335).

Segment	Idaho Listed Pollutants	Idaho Designated Beneficial Uses
Snake River: RM 409 to 396.4 Upstream Snake River (OR/ID border to Boise River Inflow)	(downstream from ID border) bacteria, dissolved oxygen, nutrients, pH, sediment	(downstream from ID border) cold water aquatic life primary contact recreation domestic water supply
Snake River: RM 396.4 to 351.6 Upstream Snake River (Boise River Inflow to Weiser River Inflow)	bacteria, nutrients, pH, sediment	Cold water aquatic life primary contact recreation domestic water supply
Snake River: RM 351.6 to 347 Upstream Snake River (Weiser River Inflow to Scott Creek Inflow)	bacteria, nutrients, pH, sediment	cold water aquatic life primary contact recreation domestic water supply
Snake River: RM 347 to 285 Brownlee Reservoir (Scott Creek to Brownlee Dam)	dissolved oxygen, mercury, nutrients, pH, sediment	cold water aquatic life primary contact recreation domestic water supply special resource water
Segment	**Oregon Listed Pollutants**	**Oregon Designated Beneficial Uses**
Snake River: RM 409 to 395 Upstream Snake River (Owyhee Basin)	mercury, temperature	public/private domestic water supply industrial water supply irrigation water, livestock watering salmonid rearing and spawning* (trout) resident fish (warm water) and aquatic life water contact recreation wildlife and hunting fishing, boating, aesthetics
Snake River: RM 395 to 335 Upstream Snake River to Farewell Bend (Malheur Basin)	mercury, temperature	public/private domestic water supply industrial water supply irrigation water, livestock watering salmonid rearing and spawning* (trout) resident fish (warm water) and aquatic life water contact recreation wildlife and hunting fishing, boating, aesthetics

* Salmonid spawning within these drainage basins is most likely to occur within the tributaries to the SR-HC TMDL reach where flow and substrate conditions are favorable to support such uses. Therefore, the salmonid spawning beneficial use designation and its accompanying water quality targets will apply to those tributaries so designated. As these tributaries are not interstate waters, and salmonid spawning use support is a localized habitat issue, state-specific targets for salmonid spawning will apply to those areas of the tributaries designated for salmonid spawning. This use has been removed from RM 347 to 285 (Brownlee Reservoir) by the State of Idaho; however, this change is still subject to action by US EPA.

as swimming, water skiing or skin diving. Such activities carry the risk of ingestion of small quantities of water. This is of particular concern in this area where recreation is a significant use of the waterbody and where recreation frequently involves primary water contact and the risk of ingesting water.

Water Quality Targets. During the majority of time that the monitoring data used in this process was being collected, both Oregon and Idaho bacteria criteria were based on fecal coliform concentrations. Recently, these standards have been updated in both states to reflect advances in understanding health risks associated with pathogen exposure in surface waters. Standards now identify *E. coli* levels in surface waters as a better mechanism for identifying health risks. The criteria of both Oregon and Idaho require waterbodies where primary contact recreation occurs to contain less than 126 *E. coli* organisms/100 mL water (as a geometric mean based on a minimum of five samples, see Table 2.2.1 for details), and an upper limit of less than 406 *E. coli* organisms/100 mL of water in any single sample. In areas where secondary contact recreation occurs the criteria of both Oregon and Idaho require waterbodies to contain less than 126 *E. coli* organisms/100 mL water (as a geometric mean based on a minimum of five samples, see Table 2.2.1 for details), and an upper limit of less than 576 *E. coli* organisms/100 mL of water. Because the criteria are the same for both states, they will be used as the bacteria targets for the SR-HC TMDL. (See Table 2.2.2)

The primary contact recreation beneficial use designation and the associated bacteria targets apply to the mainstem Snake River in the SR-HC TMDL reach (RM 409 to 188) year-round.

Common Sources. Common sources of bacteria in surface water include improperly treated sewage and septic systems as well as wastes from warm-blooded animals (domestic animals, humans and wildlife). These may enter the system directly, be carried in through tributary or agricultural inflows, or may be the result of improper disposal of boating or camping wastes.

Natural sources of bacteria (and other pathogens) include indigenous wildlife and wildfowl that utilize the watershed. While these populations are relatively stable throughout much of the year, substantial increases in some populations are observed with spring and fall migration patterns. Fluctuations in the levels of bacteria from waterfowl are especially noticeable as migration effects are directly correlated with surface water and wetland areas within the watershed.

Historical Data. There are no known historical bacteria data available in either an anecdotal or numeric format for this segment of the SR-HC TMDL reach.

Current Data. The 1986 and 1988 Water Quality Status reports for the State of Idaho (IDEQ, 1986 and 1988a), using a Water Quality Index (WQI) rating for the Snake River at Weiser, show that bacteria levels in this segment had a “fair” rating both years while the overall station conditions for all evaluated pollutants were judged to be fair in 1986 but poor in 1988. Current data collection allows *E. coli* levels to be evaluated in the Upstream Snake River segment of the SR-HC TMDL reach. Both current (*E. coli* based information) and previous (fecal coliform based) data have been used in the assessment of bacteria criteria violations in the SR-HC TMDL reach. Monitoring dates and sources are shown in Table 2.3.2. Each data set has been evaluated with its appropriate criterion (i.e. fecal coliform data using the previous fecal coliform criteria) as there is currently no approved method for the correlation of fecal coliform and *E. coli* bacteria data.

Segment Status. This listing has been evaluated using available data collected from within this segment from 1978 until present, with available recent data correlated with areas and periods of recreation use. The data show that bacteria counts (*E. coli* and fecal coliform) have not exceeded water quality criteria for primary or secondary contact recreation within the Upstream Snake River segment of the SR-HC TMDL reach over this time period. Table 2.3.3 shows summary bacteria data for the 1999 season (data for 2000 has not been controlled for quality at this time and is therefore not yet available). These data (1999 and 2000) were collected in an appropriate fashion for evaluation of the 30 day log mean, with a minimum of 5 samples over an appropriate time period collected at most sampling locations. The available data represent depth and width integrated sampling of the mainstem channel of the Snake River only. They do not assess violations of bacteria criteria within inflowing tributaries or drains.

Table 2.3.2 Bacteria monitoring for the Upstream Snake River segment of the Snake River - Hells Canyon TMDL reach (RM 409 to 335).

Segment	Bacteria Monitoring Dates	Source
Snake River: OR/ID border to Boise River Inflow (RM 409 to 396.4)	April to Oct 2000 1999 to 2000 1978 to 1980	BCPW, 2001 IPCo, 2000a US EPA STORET data, 1998a
Snake River: Boise River Inflow to Weiser River Inflow (RM 396.4 to 351.6)	April to Oct 2000 Seasonal sampling 1988 to 1989 1999 to 2000 1978 to 1980	BCPW, 2001 USGS and USBR data IPCo, 2000a US EPA STORET data, 1998a
Snake River: Weiser River Inflow to Farewell Bend (RM 351.6 to 335)	April to Oct 2000 1999 to 2000 1978 to 1979	BCPW, 2001 IPCo, 2000a US EPA STORET data, 1998a

Note: Monitoring prior to 1998 is almost exclusively fecal coliform data. Monitoring after 1998 is often both fecal coliform and *E. coli* data or *E. coli* data only.

Table 2.3.3 Summary bacteria data for the 1999 summer season in the Upstream Snake River segment of the Snake River - Hells Canyon TMDL reach (RM 409 to 335).

RM	Number of samples	***E. coli*** **(#/100 mL)**	
		Mean	Maximum
335	3	13	22
340	15	11	53
385	7	18	37
403	8	19	91

These data were collected during the summer season and correlate well not only with the period of time that conditions in the river would be conducive to bacterial growth, but also to the season of greatest primary contact recreation use. Thus, they represent the critical time period for violations within the segment. Based on these data, a recommendation has been made to delist the mainstem Snake River (RM 409 to RM 347, OR/ID border to Scott Creek inflow) for bacteria on the State of Idaho 303(d) list. This proposed delisting will be included as part of the first 303(d) list submitted by the State of Idaho subsequent to the approval of the SR-HC TMDL. However, monitoring of bacteria levels (*E. coli*) will continue to be an integral part of the water quality monitoring of the Upstream Snake River segment (RM 409 to 335). Additionally, bacteria TMDLs in other (inflowing) tributary watersheds will serve to further improve water quality in the SR-HC TMDL reach.

Dissolved Oxygen.

A portion of the Upstream Snake River segment of the SR-HC TMDL reach is listed as water quality limited due to low dissolved oxygen and the potential for non-support of designated salmonid rearing and cold water aquatic life beneficial uses. The listed stretch extends from RM 409 to RM 396.4. Additional, more detailed information on dissolved oxygen is included in Section 3.2.

General Concerns. See Section 2.2.4.1.

Water Quality Targets. See Section 2.2.4.1 and Table 2.2.2.

Common Sources. See Section 2.2.4.1.

Historical Data. Data collected from 1968 to 1974 by the US EPA in the Upstream Snake River segment (near Weiser, Idaho) and slightly upstream from RM 409 (near Marsing, Idaho) show dissolved oxygen levels that average 10 to 11 mg/L in all available water column samples. No water column dissolved oxygen levels less than the 6.5 mg/L water quality target were observed in the data available. These data were collected over a variety of seasonal variations, but do not represent continuous monitoring (US EPA, 1974a and 1975), and do not address dissolved oxygen concentrations at the sediment/water interface. Water column data collected near Weiser, Idaho (1969 to 1974) ranged from a high value of 13.6 mg/L (January, 1973) to a low of 8.4 mg/L (July, 1972 and August, 1969).

Current Data. Data collected at RM 385 (near Nyssa, Oregon) at (approximately) monthly frequency during 1975, 1976 and 1977 (US EPA, 1998a) show water column dissolved oxygen levels at mid-day that range from a high of 13.9 mg/L (February, 1977) to a low of 8.6 mg/L (June, 1977). A similar data set collected between 1975 and 1990 at RM 351 (near Weiser, Idaho), show water column dissolved oxygen levels at roughly mid-day that range from 14.2 mg/L (December, 1979) to 6.7 mg/L (June, 1979). The 1986 and 1988 Water Quality Status reports for the State of Idaho (IDEQ, 1986 and 1988a), using a WQI rating for the Snake River at Weiser, show that oxygen in this segment had a “good” rating both years while the overall station conditions for all evaluated pollutants were judged to be “fair” in 1986 but “poor” in 1988.

Water column data collected by IPCo in 1995 at three locations show dissolved oxygen levels that range from 8.8 mg/L in June to 11.8 mg/L in March (near RM 409, Adrian, Oregon); from 7.9 mg/L to 12.7 mg/L both in April (near RM 385, Nyssa, Oregon); and from 7.8 mg/L to 14.1 mg/L both in August (RM 340, near Weiser, Idaho). Preliminary data collected by the Boise City Public Works (BCPW) contractors at eight in-river and tributary locations during the spring, summer and fall of 2000 show no exceedences of the 6.5 mg/L SR-HC TMDL dissolved oxygen target (BCPW, 2001).

As outlined in Table 2.3.4, water column dissolved oxygen levels have been monitored in the Upstream Snake River segment for some time. Currently available inflow data for the SR-HC TMDL reach includes dissolved oxygen monitoring from major tributaries discharging into the SR-HC TMDL reach. Dissolved oxygen concentrations (both mainstem and inflow data) vary seasonally and with variation in annual precipitation. Lower dissolved oxygen levels are most common in late summer, when water levels are low and air temperatures are high (See Figure 2.3.5).

Table 2.3.4 Dissolved oxygen monitoring for the Upstream Snake River segment of the Snake River - Hells Canyon TMDL reach (RM 409 to 335).

Segment	Dissolved Oxygen Monitoring Dates	Source
Snake River: OR/ID border to Boise River Inflow (RM 409 to 396.4)	April to Oct 2000 Monthly 1995 to present 1978 to 1980	BCPW, 2001 IPCo, 1999d US EPA STORET data, 1998a
Snake River: Boise River Inflow to Weiser River Inflow (RM 396.4 to 351.6)	April to Oct 2000 1978 to 1980	BCPW, 2001 US EPA STORET data, 1998a
Snake River: Weiser River Inflow to Farewell Bend (RM 351.6 to 335)	April to Oct 2000 Monthly 1995 to present 1978 to 1979	BCPW, 2001 IPCo, 1999d US EPA STORET data, 1998a

<u>Segment Status</u>. Figure 2.3.5 displays the average seasonal water column dissolved oxygen concentrations for inflowing tributaries and the mainstem Snake River as observed from data collected between 1975 and 2000. Available water column data from the mouths of the tributaries show that most meet the 6.5 mg/L water column dissolved oxygen target for cool and cold water aquatic life year round (BCPW, 2001; IPCo, 2000a, 2000c; USGS, 1999; US EPA, 1998a).

Data collected in the Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach in 1995, 1996, 1999 and 2000 show no exceedences of the 6.5 mg/L water column dissolved oxygen target for cool and salmonid rearing/cold water aquatic life within this segment. However, a high level of concern in correlation with the aquatic habitat needs of larval sturgeon and other young fish is associated with dissolved oxygen concentrations the sediment/water interface. Initial qualitative evaluation of the dissolved oxygen at the sediment/water interface showed glazed appearance and odor indicative of anaerobic conditions. Available information on dissolved oxygen concentrations at the sediment/water interface immediately upstream of the SR-HC TMDL reach (upstream of RM 409) indicate that dissolved oxygen concentrations are often well below the 6.5 mg/L target value. Substrate conditions are very similar in both reaches of the Snake River. Concerns are generated due to excessive levels of algal growth and slime production leading to an environment conducive to low substrate dissolved oxygen, and increased mercury methylation.

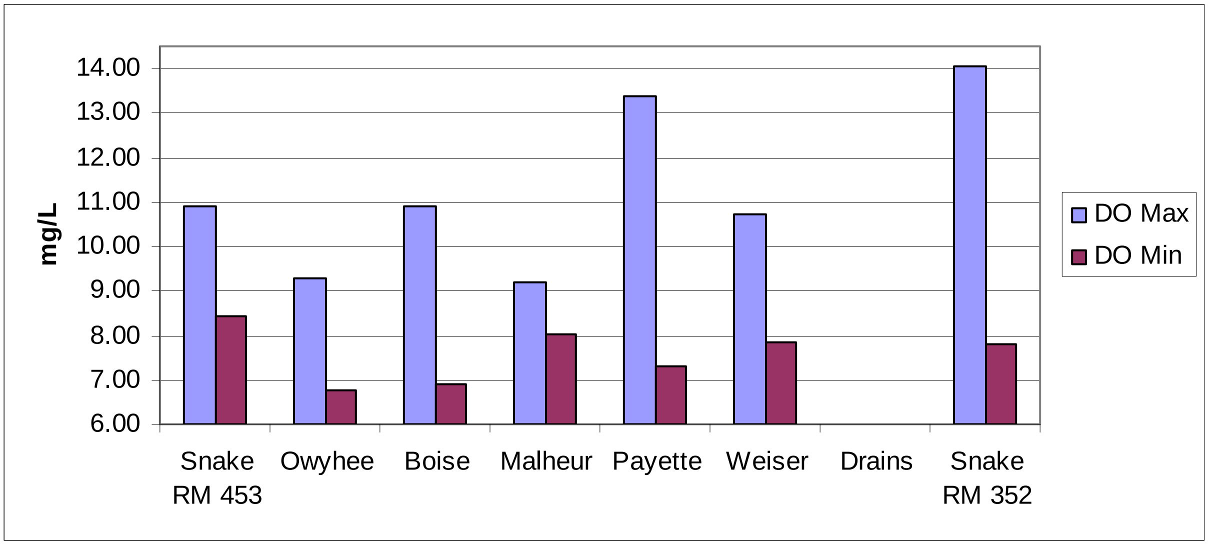

Figure 2.3.5 Mean dissolved oxygen concentrations at tributary and mainstem sites for the Upstream Snake River segment of the Snake River - Hells Canyon TMDL (RM 409 to 335), 1975 through 2000.

While this information alone is not sufficient to adequately assess the level of impairment in this segment of the SR-HC TMDL reach, it does indicate that additional data collection is necessary before a recommendation on delisting can be made. Direct determination of impaired, threatened or full support status of these designated beneficial uses on a site-specific basis will require further study and data collection. A more in-depth discussion of this concern and the available upstream data is available in section 3.2.

Mercury.

The Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach is listed as water quality limited due to a human fish-consumption advisory for mercury from the State of Oregon (Appendix D). Additional, more detailed information on mercury is included in Section 3.1.

General Concerns. See Section 2.2.4.2.

Water Quality Targets. See Section 2.2.4.2 and Table 2.2.2.

Common Sources. See Section 2.2.4.2.

Historical Data. The earliest mercury measurements in this segment date to the early 1970s, post construction of the Hells Canyon Complex as shown in Table 2.3.5. However with changes in sampling and analytical techniques it is difficult if not impossible to correlate the 1970s data with current data.

Current Data. The 1986 and 1988 Water Quality Status reports for the State of Idaho (IDEQ, 1986 and 1988a), using a WQI rating for the Snake River at Weiser, indicate that metal toxicity levels in this segment had a "fair" rating for 1986 and a "good" rating for 1988. The overall station conditions for all evaluated pollutants were judged to be "fair" in 1986 but "poor" in 1988. As outlined in Table 2.3.5, mercury levels have been monitored in the Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach over an extended period of time. The most recent data collection and analysis occurred in 1997 (Clark and Maret, 1998) and 1999 (IPCo, 2000d). However, the majority of data available are fish tissue and sediment values. Water column data are much more limited. The only water column mercury data available is a single sample from the Upstream Snake River segment at Weiser (~RM 352), collected in 1990, and two samples collected in 2001 immediately upstream of the City of Weiser Wastewater Treatment Plant. The sample collected in 1990 showed a dissolved mercury concentration less than the analytical detection limit (0.1 ug/L) (Rinella *et al.*, 1994). The samples collected in 2001 showed concentrations less than 0.01 ug/L. The analytical detection limit appropriate to the vast majority of the samples analyzed is much higher than the SR-HC TMDL target for total mercury. Therefore, the very limited available data do not provide conclusive evidence on whether or not water column mercury levels in this segment are above the target of 0.012 ug/L identified in this TMDL.

Table 2.3.5 Mercury monitoring for the Upstream Snake River segment of the Snake River - Hells Canyon TMDL reach (RM 409 to 335).

Segment	Mercury Monitoring Dates	Source
Snake River: OR/ID border to Boise River Inflow (RM 409 to 396.4)	Jan 1970 July to Sept 1990	Gebhards *et al.*, 1971 (IDFG) Buhler *et al.*, 1971 (OSU) Rinella *et al.*, 1994 (USGS)
Snake River: Boise River Inflow to Weiser River Inflow (RM 396.4 to 351.6)	Jan 1970 July to Sept 1990 Aug 1997	Buhler *et al.*, 1971 (OSU) Rinella *et al.*, 1994 (USGS) Clark and Maret, 1998 (USGS) IPCo, 2000d
Snake River: Weiser River Inflow to Farewell Bend (RM 351.6 to 335)	July to Sept 1990	Rinella *et al.*, 1994 (USGS) IPCo, 2000d

The action level for fish tissue mercury concentrations for the State of Oregon is 0.35 mg/kg. The action level for fish tissue mercury concentrations for the State of Idaho is 0.5 mg/kg (wet weight).

The data collected in 1994 and 1997 indicate that exceedences of the State of Oregon action level may be occurring in individual fish tissue samples. Data collected in 1990 and 1997 (Table 2.3.6) show a decrease in average methylmercury concentration; however, this data set is insufficient to demonstrate a conclusive downward trend for two reasons: 1. Data from 1970 cannot be compared directly due to differences in analytical techniques. 2. The size, age, weight and species sampled differ from data set to data set and are therefore not directly comparable.

Further monitoring is necessary to determine if the lower fish tissue methylmercury concentrations observed in the recent data set collected in the Upstream Snake River (RM 409 to 335) and Brownlee Reservoir (RM 335 to 285) segments of the SR-HC TMDL reach are representative of actual conditions.

Segment Status. While there is no data to show that the water column target established for the SR-HC TMDL is being exceeded, there is sufficient fish tissue mercury data to warrant a fish consumption advisory from the State of Oregon (Appendix D).

Table 2.3.6 Mercury in fish tissue in the Upstream Snake River segment (RM 409 to 335) over the past 30 years. All averages represent data over several species and age classes.

Year	Number of Samples	Mean Mercury Concentration (mg/kg wet weight)
1970	16	0.79
1990	9	0.20
1997	2	0.28

* These values are means. The range is based on the mean measured methylmercury concentration observed for a species, not an individual fish. Therefore, in 1990 some individual fish tissue data exceed the action levels set by both the State of Oregon and the State of Idaho. In 1997, some individual fish tissue data exceed the action level established by the State of Oregon.

The current status review of this segment for mercury contamination is based on fish tissue data. When considering the available fish tissue data, it is apparent that from the 1970s until present, this segment has exhibited fish tissue mercury concentrations that are of concern for human health.

Data show impairment of the designated beneficial use of fishing. Available data and information demonstrate a high level of concern for the wildlife and hunting designated beneficial use due to observed fish tissue methylmercury concentrations. Collection of water column data is required to determine whether target exceedences are occurring. This information is required in order to determine the status of cold water aquatic life, salmonid rearing, resident fish and aquatic life, domestic water supply designated beneficial uses.

Nutrients.

The Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach is listed as water quality limited due to nuisance algal growth and excessive nutrient loading. Both of these factors are of concern because of the effect excessive algal growth can have on dissolved oxygen, pH levels, and formation of trihalomethane compounds (THMs) in drinking water treatment. Additional concerns are associated with the production of cyanotoxins from cyanobacteria (blue-green algae) growth. More detailed information on these concerns is included in Section 3.2.

General Concerns. See Section 2.2.4.3.

Water Quality Targets. See Section 2.2.4.3 and Table 2.2.2.

<u>Common Sources</u>. In addition to the common sources described in Section 2.2.4.3, additional sources of nutrients to the Upstream Snake River segment (RM 409 to 335) may include natural levels of phosphorus from the mountains that rim the southeastern border of the Snake River Basin and anthropogenic releases of phosphorus to the Snake River from mining and smelting of phosphate ores upstream (US EPA, 1974a).

<u>Historical Data.</u> Anecdotal information on nutrient concentrations in the Upstream Snake River segment (RM 409 to 335) indicates that algal growth may also have occurred at noticeable levels before extensive anthropogenic impact to this reach from agricultural practices or urbanization occurred (US EPA, 1974a). The Mid-Snake River Problem Assessment (IDEQ, 1997c) cites the following: The Snake River has historically been a biologically productive system. As early as 1811, before the first anthropogenic discharge entered the river, a "light pea-green color" was observed. While there is no available mechanism to extrapolate this information to algal or nutrient concentrations in the river, one logical interpretation of this statement would be that the coloration noted was due to an accumulation of algal growth in the river system at the time of the 1811 expedition.

Mainstem data collected at (approximately) monthly frequency from 1969 to 1974 by the US EPA in the Upstream Snake River segment (near Weiser, Idaho) show total phosphorus levels that range from 0.54 mg/L (July, 1972) to 0.03 mg/L (March, 1970) with an average concentration value of 0.13 mg/L. This same study showed a range in concentration for dissolved ortho-phosphate from 0.01 mg/L (April, 1972 and June 1971) to 0.1 mg/L (November, 1970 and February and March, 1971). The mean dissolved ortho-phosphate concentration for this study was 0.05 mg/L. These data were collected over a variety of seasonal variations, but do not represent continuous monitoring (US EPA, 1998a).

Data collected for determination of aqueous phosphorus concentrations (both mainstem and inflow data) vary seasonally and with variation in annual precipitation. Inflow data varies seasonally with changes in agricultural recharge, spring runoff, subsurface contributions, and rate of instream biological processing. Annual variations also result from relative precipitation amounts, frequencies and intensities.

Data collected from 1968 to 1974 by the US EPA in the Upstream Snake River segment (near Weiser, Idaho) and slightly upstream from RM 409 (near Marsing, Idaho) show total phosphorus levels that range from an average of 0.08 mg/L near the inflow of the Boise and Owyhee Rivers to 0.120 mg/L near the Malheur and Payette River inflows. All of the average values available are above the US EPA Gold Book (US EPA, 1986b) targets for waters flowing into a lake or reservoir (0.05 mg/L).

Nitrate/nitrite levels in this segment averaged 0.5 mg/L to 0.75 mg/L near the inflow of the Malheur and Payette Rivers and the Boise and Owyhee Rivers respectively. These data were collected over a variety of seasonal variations, but do not represent continuous monitoring (US EPA, 1974a and 1975).

The biology of the Snake River was the subject of a Ph.D. dissertation authored by Lyle Stanford in 1942 (Stanford, 1942). Dr. Stanford's observations and data (collected in 1941 and 1942) show plankton in the un-impounded SR-HC TMDL reach to be dominated by diatoms. Green algae were abundant in backwater areas and oxbow lakes. Some cyanobacteria (blue-greens) were also observed but were not the dominant population even in the summer season.

A study completed approximately 20 years later by IDFG (IDFG, 1961) details the water quality condition of the Snake River between Adrian, Oregon and Weiser, Idaho. General conclusions from the report include:

(1) All inflowing tributaries were observed to carry excessive loading of sediment. Excessive nutrient loading from the tributaries was suspected because of "great algal blooms in most areas".
(2) The Snake River was observed to carry an "exceptionally heavy load of algae in suspension". Dominant algae types were identified as blue greens (*Anabaena*, *Pediastrum*, *Spirogyra*, *Aphanizomenon*, *Staurastrum*, and *Anacystis*).
(3) The river was observed to carry a high organic load, which "appears to exceed by many fold all sources of industrial and domestic wastes in the study area".
(4) Areas of "gross organic pollution" (slimes) were identified to occur in the Snake River on the Oregon side below the City of Ontario.
(5) Fish populations of the Malheur, Weiser and possibly Owyhee rivers were hypothesized to be limited by high turbidity.

<u>Current Data</u>. Data collected at RM 385 (near Nyssa, Oregon) at (approximately) monthly frequency during 1975, 1976, 1977 and 1990 (US EPA, 1998a) show total phosphorus concentrations that range from 0.02 mg/L (January, 1975) to 0.14 mg/L (July, 1976), with a mean total phosphorus concentration of 0.08 mg/L. A similar data set collected between 1975 and 1990 at RM 351 (near Weiser, Idaho), show total phosphorus levels that range from 0.02 mg/L (July 1976) to 0.22 mg/L (March 1984), with a mean total phosphorus concentration of 0.14 mg/L. Dissolved ortho-phosphate values collected from 1981 to 1990 range from 0.01 mg/L (July, 1984 and December, 1989) to 0.1 mg/L (November, 1981 and January, 1982). The 1986 and 1988 Water Quality Status reports for the State of Idaho (IDEQ, 1986 and 1988a) list nutrients as a primary pollutant in this segment. WQI ratings for the Snake River at Weiser in these studies show that the trophic status of this segment had a "fair" rating for both years while the overall station conditions are judged to be "fair" in 1986 but "poor" in 1988. These studies found cold water aquatic life and salmonid spawning in this segment to be only partially supported and other beneficial uses to be potentially at risk due in part to the trophic status of this segment.

Currently available inflow data for the Upstream Snake River segment (RM 409 to 335) includes aqueous samples from major tributaries discharging into the SR-HC TMDL reach (Figures 2.3.6 and 2.3.7). The majority of the data are grab samples, but some depth-integrated sampling information is available. Data sources are listed in Tables 2.3.7.

Data collected by IPCo between 1996 to 1999 show an increasing trend in total phosphorus concentrations in the Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach and distance downstream.

During the critical summer months (June through September) when conditions for algal growth are optimal, concentrations at RM 413 (near where the Snake River enters the SR-HC TMDL reach) average 0.09 mg/L total phosphorus, 0.02 mg/L ortho-phosphate and 22 ug/L chlorophyll *a* (1995 to 1999). At RM 385 (below the Owyhee and Boise river inflows) concentrations average

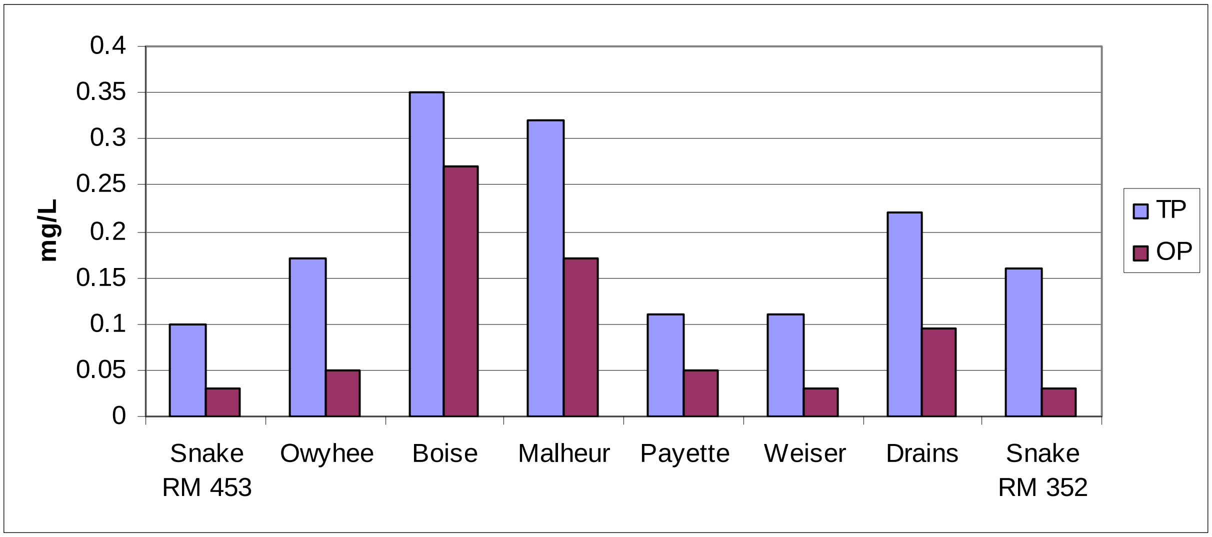

Figure 2.3.6 Median total phosphorus (TP) and ortho-phosphate (OP) concentrations for tributary and mainstem sites within the Upstream Snake River segment of the Snake River - Hells Canyon TMDL (RM 409 to 335).

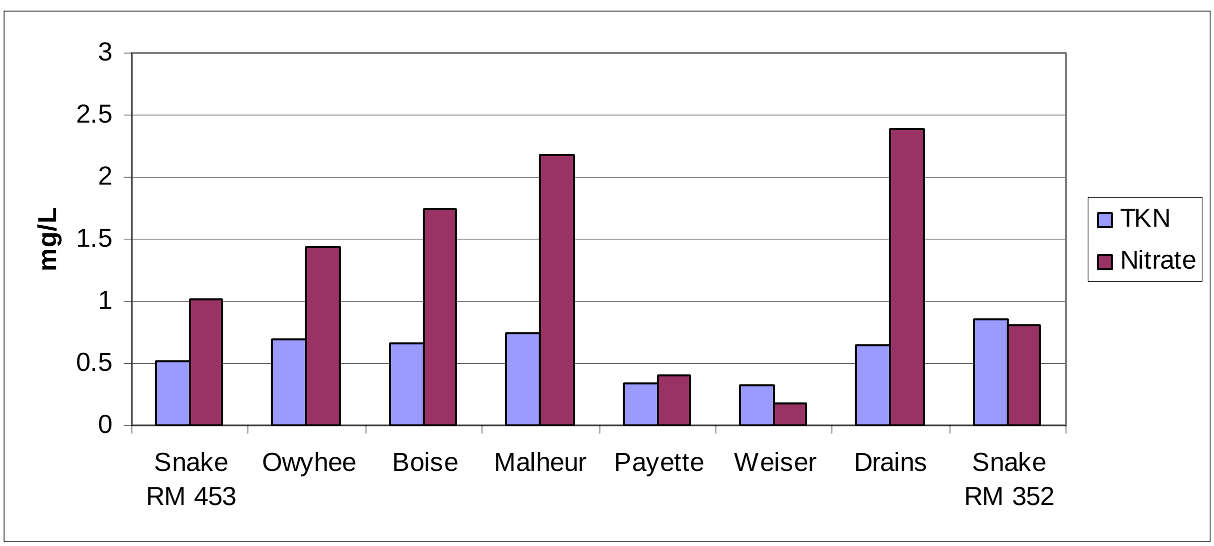

Figure 2.3.7 Median nitrate and total Kjeldahl nitrogen (TKN) concentrations for tributary and mainstem sites within the Upstream Snake River segment of the Snake River - Hells Canyon TMDL (RM 409 to 335).

0.12 mg/L total phosphorus, 0.02 mg/L ortho-phosphate and 24 ug/L chlorophyll *a* (1995 to 1999). At RM 351 (below the Malheur and Payette river inflows, near the Weiser River inflow) concentrations average 0.13 mg/L total phosphorus, 0.02 mg/L ortho-phosphate and 34 ug/L chlorophyll *a* (1995 to 1999). At RM 340 (near the head of Brownlee Reservoir) concentrations average 0.13 mg/L total phosphorus, 0.02 mg/L ortho-phosphate and 30 ug/L chlorophyll *a* (1995 to 1999). Within this same data set, chlorophyll *a* varied from 3 to 51 ug/L at the Adrian, Oregon site; from 2 to 107 ug/L at the Nyssa, Oregon site; and from 2 to 84 ug/L at the Weiser, Idaho site (Figure 2.3.8). Data sources for chlorophyll *a* are listed in Table 2.3.8.

Table 2.3.7 Nutrient monitoring for the Upstream Snake River segment of the Snake River - Hells Canyon TMDL reach (RM 409 to 335).

Segment	Nutrient Monitoring Dates	Source
Snake River: OR/ID border to Boise River Inflow (RM 409 to 396.4)	April to Oct 2000 Monthly 1995 to present Summer 1992 1974 to 1977, 1978 to 80	BCPW, 2001 IPCo, 1998a, 1998b, 2000a IDEQ, 1993b US EPA STORET data, 1998a
Snake River: Boise River Inflow to Weiser River Inflow (RM 396.4 to 351.6)	April to Oct 2000 Monthly 1995 to present Summer 1992 1977 to 1980	BCPW, 2001 IPCo, 1998a, 1998b, 2000a IDEQ, 1993b US EPA STORET data, 1998a
Snake River: Weiser River Inflow to Farewell Bend (RM 351.6 to 335)	April to Oct 2000 Monthly 1995 to present Summer 1992 1974 to 1975, 1978 to 1979	BCPW, 2001 IPCo, 1998a, 1998b, 2000a IDEQ, 1993b US EPA STORET data, 1998a

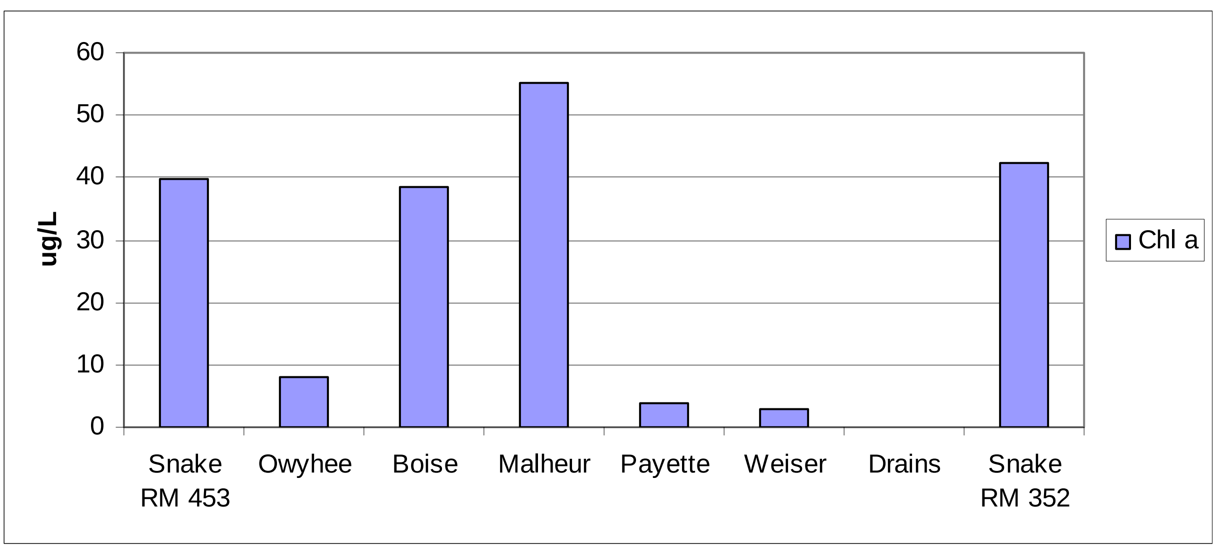

Figure 2.3.8 Mean chlorophyll *a* concentrations for tributary and mainstem sites within the Upstream Snake River segment of the Snake River - Hells Canyon TMDL.

As discussed in Section 2.2.4.3, there are two major nutrients of concern in surface water systems, phosphorus and nitrogen. However in systems where cyanobacteria (blue-green algae) are routinely a dominant community, phosphorus is the nutrient most likely to be limiting as these organisms can fix nitrogen from the air/water interface. Both cyanobacteria (blue-green algae) and diatoms have been observed as dominant populations in the Upstream Snake River segment (RM 409 to 335) depending on the season, water quality, and water temperature (IDEQ, 1993b; IDFG, 1961).

Table 2.3.8 Chlorophyll *a* (as an index for algae) monitoring for the Upstream Snake River segment of the Snake River - Hells Canyon TMDL reach (RM 409 to 335).

Segment	Chlorophyll *a* Monitoring Dates	Source
Snake River: OR/ID border to Boise River Inflow (RM 409 to 396.4)	April to Oct 2000 Monthly 1995 to present Summer 1992 1988 to 1996	BCPW, 2001 IPCo, 1998a, 1998b, 2000a IDEQ, 1993b US EPA STORET data, 1998a
Snake River: Boise River Inflow to Weiser River Inflow (RM 396.4 to 351.6)	April to Oct 2000 Monthly 1995 to present Summer 1992 1973 to 1974, 1978 to 1988, 1995	BCPW, 2001 IPCo, 1998a, 1998b, 2000a IDEQ, 1993b US EPA STORET data, 1998a
Snake River: Weiser River Inflow to Farewell Bend (RM 351.6 to 335)	April to Oct 2000 Monthly 1995 to present Summer 1992	BCPW, 2001 IPCo, 1998a, 1998b, 2000a IDEQ, 1993b US EPA STORET data, 1998a

Recent monitoring within the Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach indicates that water quality (as defined by a combination of algal and phosphorus concentrations) tends to degrade with increasing distance downstream.

Because of the relationship between nutrients, algae and dissolved oxygen within a surface waterbody, algal biomass has been monitored through sampling and analysis for chlorophyll *a* and pheophytin (a metabolite of chlorophyll *a*). Data available from both nutrient and algal monitoring has been identified as an important part of the assessment of water quality. Therefore, these data have been included in the monitoring information on algae even though they are not specifically listed as parameters on the 303(d) list.

<u>Segment Status</u>. Monitoring data collected from tributaries inflowing to the Snake River regularly exceed the total phosphorus target for the SR-HC TMDL reach. Available data showed that in a low water year (1992 to 1993), the median total phosphorus concentration in inflowing tributary waters was consistently 0.2 to 0.4 mg/L. Median mainstem Snake River concentrations at the same time were approximately 0.1 mg/L (IDEQ, 1993b; USGS, 1999; US EPA, 1998a). During this same time, ortho-phosphate made up approximately 30 percent of the total phosphorus load in the mainstem Snake River, and averaged 57 percent of the total phosphorus load from the inflowing tributaries. In an average water year the median total phosphorus concentration in inflowing tributary waters ranged from 0.2 to over 0.3 mg/L. Median mainstem Snake River concentrations at the same time ranged from approximately 0.1 to 0.2 mg/L (BCPW, 2001; IPCo, 1998a, 1998b, 2000a; US EPA, 1998a; USGS, 1999). During this same

time, ortho-phosphate made up approximately 30 percent of the total phosphorus load in the mainstem Snake River, and averaged 62 percent of the total phosphorus load from the inflowing tributaries.

In general, median total phosphorus concentrations observed at the mouth of the Boise and the Malheur Rivers are the highest of the inflowing tributaries (0.35 and 0.32 mg/L respectively). Total phosphorus concentrations in the Weiser River (~0.10 mg/L) are the lowest of the inflowing tributaries (BCPW, 2001; IPCo, 1998a, 1998b, 2000a; US EPA, 1998a; USGS, 1999). In general, median ortho-phosphate concentrations observed at the mouth of the Boise and the Malheur rivers are the highest of the inflowing tributaries (0.27 and 0.17 mg/L respectively). Ortho-phosphate concentrations in the Snake (upstream of RM 409) and Weiser rivers are the lowest of the inflowing tributaries to the Upstream Snake River segment (0.03 mg/L) (BCPW, 2001; IPCo, 1998a, 1998b, 2000a; US EPA, 1998a; USGS, 1999). Figure 2.3.6 displays the median total and ortho-phosphate concentrations for inflowing tributaries and the mainstem Snake River as observed from data collected during recent average water years.

In the case of nitrogen loading, available data show that in a low water year (1992 to 1993), the range of median total nitrogen (TN) concentrations in inflowing tributary waters was 0.30 mg/L to 4.9 mg/L. Median mainstem Snake River total nitrogen concentrations at the same time were approximately 0.7 mg/L (BCPW, 2001; IDEQ, 1993b; USGS, 1999; US EPA, 1998a). In an average water year the median nitrate concentration in inflowing tributary waters ranged from 0.17 mg/L to over 2.35 mg/L. Median mainstem Snake River concentrations at the same time ranged from approximately 1.1 mg/L to 1.5 mg/L (BCPW, 2001; IPCo, 1998a, 1998b, 2000a; US EPA, 1998a; USGS, 1999).

In general, median nitrogen concentrations (nitrate and total kjeldahl nitrogen (TKN)) observed at the mouth of the drains and the Malheur River are the highest of the inflowing tributaries (2.39 mg/L and 0.64 mg/L; and ~2.18 mg/L and 0.74 mg/L respectively). Median nitrogen concentrations (nitrate and TKN) in the Weiser and Payette rivers are the lowest of the inflowing tributaries (0.17 mg/L and 0.32 mg/L; and 0.41 mg/L and 0.34 mg/L respectively). Figure 2.3.7 displays median nitrogen concentrations for inflowing tributaries and the mainstem Snake River as observed from data collected during recent average water years.

In addition to the nutrient loads entering the system, algae is both grown in place in the mainstem Snake River and transported into this segment from the inflowing tributaries (Figure 2.3.8). A study completed during a dry water year (IDEQ, 1993b) showed that chlorophyll *a* concentrations ranged from 0.01 mg/L to 0.09 mg/L, with concentrations increasing upstream to downstream. This same study observed that inflowing tributary chlorophyll *a* concentrations were markedly lower than mainstem Snake River concentrations in this segment. More recent monitoring (1994 through 1999) supports this trend, showing chlorophyll *a* levels in the mainstem often measured at five to eight times higher than those in the inflowing tributaries (IPCo, 1998a, 1998b, 1999c, 1999d, 2000a).

Available data and information show impairment of aesthetic and recreational uses due to excessive algal growth and slime production. Available data and information also demonstrate a high level of concern for cold water aquatic life, salmonid rearing, resident fish and aquatic life, fishing, and domestic water supply designated beneficial uses, and endangered species support. Concerns are generated due to excessive levels of algal growth and slime production leading to an environment conducive to low substrate dissolved oxygen (specific to young fish and other aquatic life at the sediment/water interface), increased mercury methylation, and potential for cyanotoxin production. Endangered species concerns center around support for the Idaho Springsnail (present in this segment), that requires free flowing, clear, cold water environments. Determination of impaired, threatened or full support status of these designated beneficial uses will require further study and data collection.

pH.

The Upstream Snake River segment (RM 409 to RM 335) of the SR-HC TMDL reach is listed for pH. Additional, more detailed information on pH is included in Section 3.4.

General Concerns. See Section 2.2.4.4.

Water Quality Targets. See Section 2.2.4.4 and Table 2.2.2.
Common Sources. See Section 2.2.4.4.

Historical Data. Data collected from 1968 to 1974 by the US EPA in the Upstream Snake River segment (RM 409 to 335) show a fairly narrow range of pH values from 7.5 to 9.0 at RM 361 (near Weiser, Idaho) and between 7.7 and 8.5 slightly upstream from RM 409 (near Marsing, Idaho). These data were collected over a variety of seasonal variations, but do not represent continuous monitoring (US EPA, 1974a and 1975).

Current Data. Data collected from 1975 to 1991 by the US EPA in the Upstream Snake River segment also show a fairly narrow range of pH values. Values range from 7.5 to 9.1 at RM 361 (near Weiser, Idaho). Exceedences of the pH target for the SR-HC TMDL (7.0 to 9.0) occurred less than 1 percent of the time. A study over a similar time period but with less frequent sampling slightly upstream from RM 409 (near Marsing, Idaho) showed a range of pH values from 7.5 to 8.9. These data were collected over a variety of seasonal variations, but do not represent continuous monitoring (US EPA, 1974a and 1975).

The 1986 and 1988 Water Quality Status reports for the State of Idaho (IDEQ, 1986 and 1988a), using a WQI rating for the Snake River at Weiser, show that pH in this segment had a "good" rating both years while the overall station conditions for all evaluated pollutants were judged to be "fair" in 1986 but "poor" in 1988. As outlined in Table 2.3.9, pH levels have been monitored over a considerable time period in the Upstream Snake River segment of the SR-HC TMDL reach.

Currently available inflow pH data for the SR-HC TMDL reach includes the inflowing tributaries and the mainstem Snake River. Data collected by IPCo during 1995 at three locations in the Upstream Snake River segment of the SR-HC TMDL reach show pH levels that range from 8.2 to 8.9 near RM 409, Adrian, Oregon; from 7.1 to 8.9 near RM 385, Nyssa, Oregon; and from 8.3 to 9.0 at RM 340, near Weiser, Idaho. An evaluation of all available pH data for the Upstream Snake River segment of the SR-HC TMDL reach show less than 1 percent exceedence of the 7.0 to 9.0 pH target.

Table 2.3.9 pH monitoring for the Upstream Snake River segment of the Snake River - Hells Canyon TMDL reach.

Segment	pH Monitoring Dates	Source
Snake River: OR/ID border to Boise River Inflow (RM 409 to 396.4)	April to Oct 2000 1995 1960 to 1996	BCPW, 2001 IPCo data US EPA STORET data, 1998a
Snake River: Boise River Inflow to Weiser River Inflow (RM 396.4 to 351.6)	April to Oct 2000 Summer sampling 1988 to 1989 1995 1957 to 1990, 1995	BCPW, 2001 USGS & USBR data IPCo data US EPA STORET data, 1998a
Snake River: Weiser River Inflow to Farewell Bend (RM 351.6 to 335)	April to Oct 2000 1995 1974, 1978 to 1979, 1988 to 1989	BCPW, 2001 IPCo data US EPA STORET data, 1998a

<u>Segment Status</u>. The listing of pH as a pollutant impairing designated beneficial uses in the Snake River (RM 409 to 335) has been evaluated using available data collected from within this segment. The data show that exceedence of the SR-HC TMDL pH targets occur less in less than 1 percent of the data (the total number of samples is greater than 300). Figure 2.3.9 shows summary pH for the 1995 to 1999 years. Based on these data, a recommendation has been made to delist the mainstem Snake River (RM 409 to RM 347, OR/ID border to Scott Creek inflow) for pH on the State of Idaho, 303(d) list. This proposed delisting will be included as part of the first 303(d) list submitted by the State of Idaho subsequent to the approval of the SR-HC TMDL. However, monitoring of pH levels will continue to be an integral part of the water quality monitoring of the mainstem Snake River (RM 409 to RM 335).

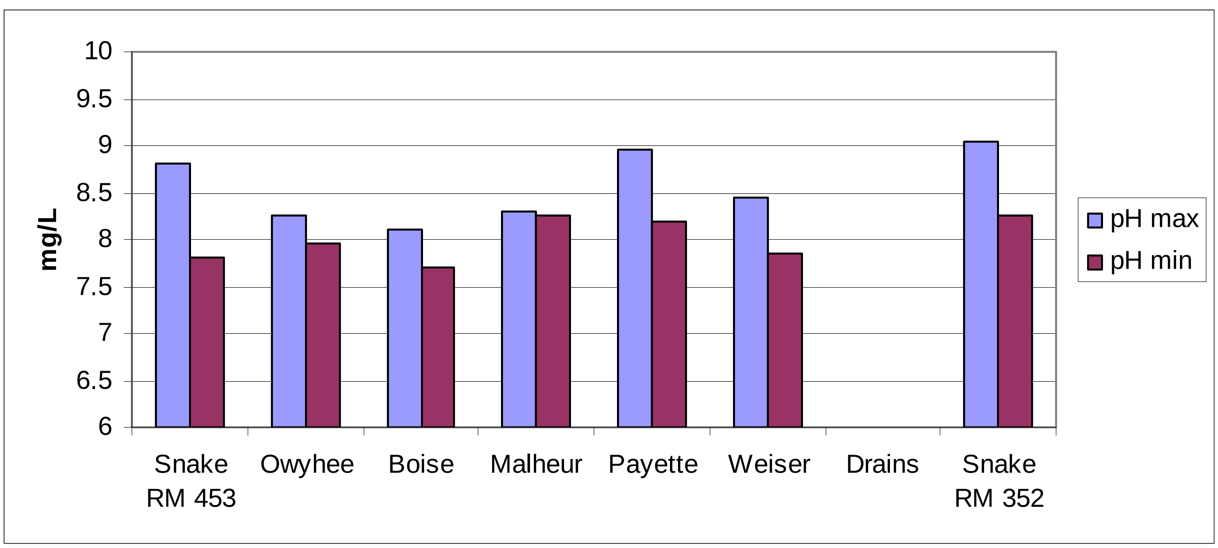

Figure 2.3.9 Measured maximum and minimum pH levels for tributary and mainstem sites within the Upstream Snake River segment of the Snake River - Hells Canyon TMDL.

Sediment.

The Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach is listed for excessive sediment. Additional, more detailed information on sediment is included in Section 3.5.

General Concerns. See Section 2.2.4.5.

Water Quality Targets. See Section 2.2.4.5 and Table 2.2.2.

Common Sources. See Section 2.2.4.5.

Historical Data. This segment of the SR-HC TMDL reach has historically carried a substantial sediment load particularly during spring runoff (US EPA, 1974a). However there is little quantitative data from earlier periods (particularly prior to the construction of the Hells Canyon Complex).

Current Data. Data collected as part of a US EPA study from 1978 to 1990 at RM 361 near Weiser, Idaho (RM 351.6) show total suspended solids (TSS) data that range from 5 mg/L to 211 mg/L. While these data show instantaneous values that are in excess of those identified as sediment targets for the SR-HC TMDL, they were not collected in a fashion that would allow determination of duration. The 1986 and 1988 Water Quality Status reports for the State of Idaho (IDEQ, 1986 and 1988a) list sediment as a primary pollutant in this segment. WQI ratings for the Snake River at Weiser in these studies show that solids in this segment had a "fair" rating for both years while the overall station conditions were judged to be "fair" in 1986 but "poor" in 1988. These studies found cold water aquatic life and salmonid spawning in this segment to be only partially supported and other beneficial uses to be potentially at risk due in part to suspended sediments concentrations. Total suspended sediment data have been collected for the Upstream Snake River segment of the SR-HC TMDL reach as shown in Table 2.3.10.

Table 2.3.10 Total suspended solids (TSS) monitoring for the Upstream Snake River segment of the Snake River - Hells Canyon TMDL reach (RM 409 to 335).

Segment	TSS Monitoring Dates	Source
Snake River: OR/ID border to Boise River Inflow (RM 409 to 396.4)	April to Oct 2000 1995 1965 to 1996	BCPW, 2001 IPCo, 2000a US EPA STORET data, 1998a
Snake River: Boise River Inflow to Weiser River Inflow (RM 396.4 to 351.6)	April to Oct 2000 1995 1960 to 1990, 1995	BCPW, 2001 IPCo, 2000a US EPA STORET data, 1998a
Snake River: Weiser River Inflow to Farewell Bend (RM 351.6 to 335)	April to Oct 2000 1995 1974 to 1975, 1978 to 1979, 1988 to 1989, 1995 to 1997	BCPW, 2001 IPCo, 2000a US EPA STORET data, 1998a

Segment Status. An evaluation of all inflowing and mainstem total suspended sediment data showed that the lowest average concentrations are observed in the Payette (13 mg/L) and Weiser rivers (15 mg/L) and in the mainstem Snake River near Murphy (15 mg/L). The highest average TSS concentrations observed occurred in the Owyhee (50 mg/L) and Malheur rivers (44 mg/L). Figure 2.3.10 displays the average total suspended sediment concentrations for inflowing tributaries and the mainstem Snake River as observed from data collected between 1970 and 1999.

Within the Upstream Snake River segment (RM 409 to 335), the majority of water in the inflowing Snake River is a combination of that released from CJ Strike Dam (RM 494) and Swan Falls Dam (RM 458) and irrigation return flows to the river. The tributaries inflowing to this segment contain numerous reservoirs and other impoundments and diversion structures. Nearly all reservoirs are operated for irrigation storage, and act to reduce overall flow variability within the tributary and mainstem systems. These structures also act as “settling ponds” and localize sedimentation within the reservoir systems. The amount of flow alteration occurring due to irrigation management varies from one tributary to the next. The two tributaries with the least management are the Weiser and Payette Rivers. However, all are substantially altered by impoundments and diversions.

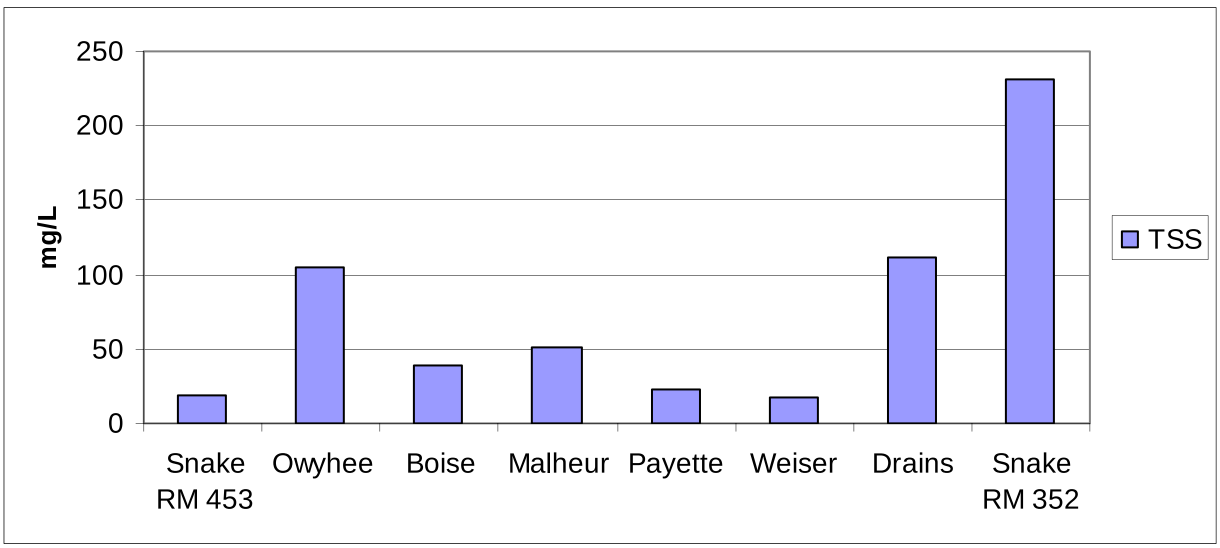

Figure 2.3.10 Mean total suspended solids (TSS) concentrations for tributary and mainstem sites within the Upstream Snake River segment of the Snake River - Hells Canyon TMDL.

While variability in the tributary systems follows a natural sequence of snow melt (high flows in the early spring) and dry summers (low flows in late July and August), most of the river systems tributary to the Upstream Snake River segment do not currently reflect historical velocities or flow. Sediment transport in the Snake River and its tributaries is complex. For example, flood control and irrigation management may result in slower, lower-flow spring seasons with the peak flows spread over a greater time frame than would be observed in an un-impounded system. In contrast, anthropogenic stream channelization actions may increase flow velocities in segments of the Snake River system. While the reduction in flow velocity due to flood control and diversion may cause less overall erosion of stream banks, dams cause sediment deposition within the reservoir systems; isolation of floodplain areas through stream channelization may increase erosion and limit floodplain deposition of sediments. Primary erosion impacts occur during spring runoff when flow volumes and velocities are greatest. However, while sediment transport still occurs within the river systems, overall sediment delivery to locations downstream of the impoundments is substantially reduced.

Sediment TMDLs are scheduled or completed for the Owyhee River, the Boise River, the Payette River, the Weiser River and many of the smaller tributaries that discharge to major tributaries within the SR-HC system. It is expected that, if successfully implemented, these TMDL efforts will result in improvement of sediment concentrations within these segments.

Available data do not contain duration information and therefore are not sufficient to determine if target exceedences are occurring. This information is needed to determine the support status of cold water aquatic life, salmonid rearing, or residential fish and aquatic life designated beneficial uses. However, sediment data do show elevated total suspended sediment concentrations occurring in a sufficiently consistent manner to be of concern. Therefore, sediment targets are set to be protective of these uses. Additionally, due to the fact that sediment acts as a primary transport mechanism for adsorbed pollutants, sediment targets and monitored trends will function as an indicator of changes in transport and delivery for these attached pollutants.

Temperature.

The Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach is listed for temperature due to violations of the Oregon and Idaho water quality standards, including the numeric and narrative criteria for cold water aquatic life, resident fish and aquatic life, and salmonid rearing. Additional, more detailed information on temperature is included in Section 3.6.

<u>General Concerns</u>. See Section 2.2.4.6.

<u>Water Quality Targets</u>. See Section 2.2.4.6 and Table 2.2.2.

<u>Common Sources</u>. See Section 2.2.4.6.

<u>Historical Data</u>. Available historical temperature data from the Upstream Snake River segment (RM 409 to 335) show single, daily measurements indicate a probable exceedence of the temperature targets for salmonid rearing/cold water aquatic life (see Table 2.2.1). However, the data are not sufficient to assess whether or not the overall temperature targets for either salmonid rearing/cold water aquatic life was being exceeded as there is no way to determine if the data available represent daily maximum temperatures. In addition, there is no historic data that would allow comparisons to a 7-day moving average of the maximum temperatures. These data however, when combined with available air temperature data, indicate that waters in this segment experience substantial warming due to non-anthropogenic sources. Data collected roughly monthly from 1968 to 1974 by the US EPA in the Upstream Snake River segment slightly upstream from RM 409 (near Marsing, Idaho) show water temperatures that range from 12 ^{o}C to 13 ^{o}C near the inflow of the Malheur and Payette Rivers and near the inflow of the

Boise and Owyhee Rivers. A similar study from 1969 to 1974 at RM 361 (near Weiser, Idaho) show temperatures ranging from 2 ^{o}C in December, 1971 (air temperature at –3.5 ^{o}C) to 25.5 ^{o}C in July, 1971 and August, 1973 (air temperature at 38 ^{o}C and 35.5 ^{o}C respectively). Roughly 20 percent of these data show temperatures above 17.8 ^{o}C (all occurring during July or August). Roughly 20 percent of these data also show temperatures above 22 ^{o}C (all occurring during July or August). These data were collected over a variety of seasonal variations, but do not represent continuous monitoring (US EPA, 1974a, 1975, 1999).

Current Data. Data collected by the US EPA in the Upstream Snake River segment at RM 385 (near Nyssa, Oregon) at (approximately) monthly frequency from 1975 to 1991 show temperature levels that range from 1 ^{o}C in December 1975 (air temperature at 0 ^{o}C) to 26 ^{o}C in July 1977 (air temperature at 29 ^{o}C). Roughly 30 percent of these data show temperatures above 17.8 ^{o}C (all occurring during July or August). Roughly 28 percent of these data also show temperatures above 22 ^{o}C (all occurring during July or August). A similar study from 1975 to 1991 at RM 361 (near Weiser, Idaho) show temperatures ranging from 1 ^{o}C in February, 1975, January, 1988 and March 1989 (air temperature at 2.5 ^{o}C, -1.0 ^{o}C and 2.5 ^{o}C respectively) to 27 ^{o}C in July, 1975 (air temperature at 37 ^{o}C).

Table 2.3.11 Water temperature monitoring for the Upstream Snake River segment of the Snake River - Hells Canyon TMDL reach (RM 409 to 335).

Segment	Temperature Monitoring Dates	Source
Snake River: OR/ID border to Boise River Inflow (RM 409 to 396.4)	April to Oct 2000 1995 1967 to 1996 1961 to 1999	BCPW, 2001 IPCo, 1998a, 2000a US EPA STORET data, 1998a WRCC, 2000
Snake River: Boise River Inflow to Weiser River Inflow (RM 396.4 to 351.6)	April to Oct 2000 Summer sampling 1980 to 1992 1995 1957 to 1992, 1995 1961 to 1999	BCPW, 2001 USGS & USBR IPCo, 1998a, 2000a US EPA STORET data, 1998a WRCC, 2000
Snake River: Weiser River Inflow to Farewell Bend (RM 351.6 to 335)	April to Oct 2000 1995 1974 to 1975, 1978 to 1979, 1989	BCPW, 2001 IPCo, 1998a, 2000a US EPA STORET data, 1998a

Roughly 21 percent of these data show temperatures above 17.8 ^{o}C (all occurring during July or August). Approximately 10 percent of these data also show temperatures above 22 ^{o}C (all occurring during July or August). These data were collected over a variety of seasonal variations, but do not represent continuous monitoring (US EPA, 1974a, 1975, 1999). The 1986 and 1988 Water Quality Status reports for the State of Idaho (IDEQ, 1986 and 1988a), using a WQI rating for the Snake River at Weiser, show that temperature levels in this segment had a “fair” rating both years while the overall station conditions for all evaluated pollutants were judged to be “fair” in 1986 and “poor” in 1988. Current water temperature data available for the Upstream Snake River segment (RM 409 to 335) include monitoring of both tributary and mainstem values. Water temperature data for some areas of the drainage extend back to the 1950's, and represent a variety of annual precipitation levels (high and low). Daily maximum, mean and minimum water temperatures are recorded in several areas of the Upstream Snake River segment, but collection frequency and period of record varies.

Concurrent air temperature data for some areas extends back to the 1950's and represents a range of seasonal and annual climate variations. Daily maximum, mean and minimum air temperatures are recorded for the last 10 years for most monitoring stations. Idaho sites include weather stations at Boise, Brownlee Dam, Caldwell, Cambridge, Council, Lewiston, Nampa, Parma, Payette, Riggins and Weiser. Oregon sites include: Adrian, Durkee, Halfway, Huntington, Malheur, Nyssa, Ontario, Owyhee dam, Richland and Vale (SNOTEL, 2000).

Segment Status. As water moves downstream from CJ Strike Dam toward the SR-HC TMDL reach, solar radiation and high air temperatures combine with warmer irrigation return flows entering the Snake River to raise temperatures in the mainstem river channel. Daily maximum and minimum water temperatures show a wider overall range and greater total variance as distance downstream from CJ Strike Dam increases (IPCo, 1998a, 1998b).

As shown in Figure 2.3.11, water temperatures within the mainstem Snake River vary from an average of 4 ^{o}C in the winter months to 24 ^{o}C in the summer, well above the numeric cold water aquatic life target of 17.8 ^{o}C.

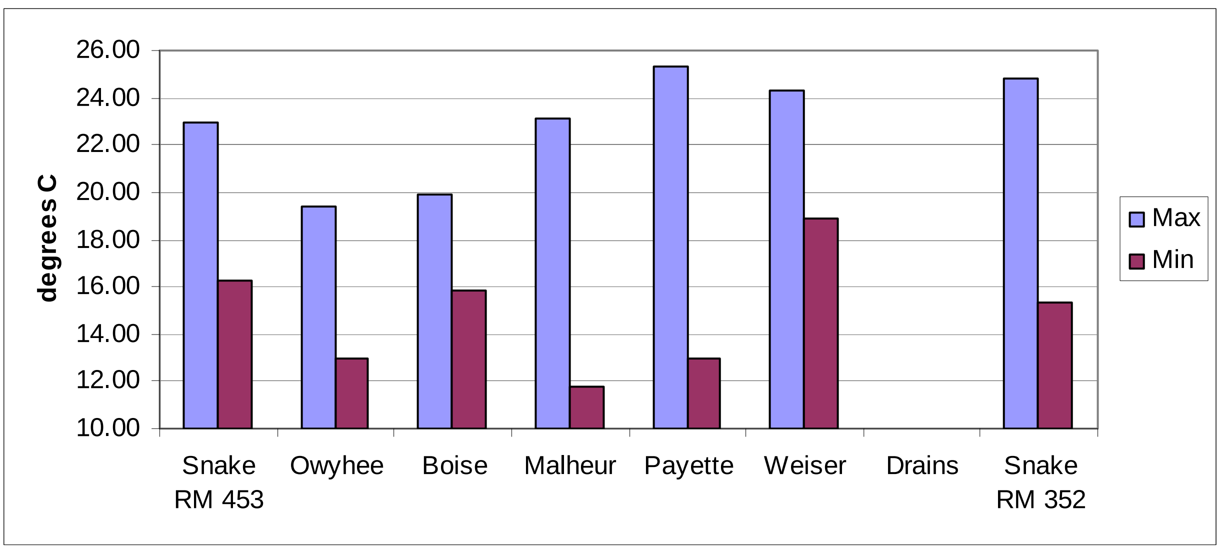

Figure 2.3.11 Mean water temperature values for tributary and mainstem sites within the Upstream Snake River segment of the Snake River - Hells Canyon TMDL (RM 409 to 335).

A temperature TMDL has been written for the Middle, North and South Forks of the Owyhee River, which, if successfully implemented, will result in attainment of State of Idaho water quality temperature standards within these segments (IDEQ, 1999c, 2000a). In this TMDL, temperature increases in the upstream segments of the Owyhee River within the state of Idaho were determined to be the result of natural heat exchange through high air temperatures, solar radiation and heating by rhyolitic outcroppings through which the river passes. Water temperatures in the South Fork Owyhee River at the Nevada/Idaho state line have been determined to exceed Idaho State temperature standards. A TMDL has been written and approved that requires Idaho temperature standards to be met by the State of Nevada at the Nevada/Idaho state line (IDEQ, 1999c).

Temperature is not listed in the lower Owyhee or Malheur rivers by the State of Oregon because salmonid spawning and rearing are not designated beneficial uses in these sections of the two rivers, except in the Owyhee River where they are designated in and above the Owyhee Reservoir. Therefore temperature assessments developed by ODEQ for the lower Owyhee and Malheur will be specific to the needs of the downstream SR-HC TMDL reach. It should be noted however that the hot, dry climate of the watersheds, and the fact that native vegetation in the drainages is relatively low growing and sparse (providing little shading on major tributaries), will play a major role in attainable water temperatures in this drainage. As shown in Figure 2.3.11, water temperatures in the Owyhee River range from an average of 4 ^{o}C in the winter months to 17 ^{o}C in the summer. The water temperatures in the Malheur River are slightly warmer and range from an average of 4 ^{o}C in the winter months to 23 ^{o}C in the summer.

Water temperatures in exceedence of the SR-HC TMDL cold water aquatic life target have been observed within the Boise (measured near Parma), Payette, and Weiser Rivers at their respective confluences with the Snake River during the months of July and August. The Lower Boise River TMDL cites the primary source of high water temperature as climatic influences such as elevated air temperatures (IDEQ, 1998a). The Lower Payette River subbasin assessment (IDEQ, 1999b) found that although water temperatures exceeding the temperature criteria for the support of cold water aquatic life, a cold/cool water fishery was supported in the river. This TMDL cited the inflowing waters from Black Canyon Dam as one cause of elevated water temperature in the Lower Payette River system as these waters already exceeded the state temperature criteria.

It is highly probable that a major source of high water temperature in all tributary drainages is climatic conditions that include hot, dry summers and native vegetation that is low growing and sparse. Other inputs of heat load to these river systems such as irrigation drains and wastewater treatment plants are estimated to contribute only modest percentages of the total temperature increases that occur in the rivers (IDEQ, 1998a). Geothermal sources are also present in some areas of the watershed, especially the Malheur River drainage.

As shown in Figure 2.3.11, water temperatures in the Boise River range from an average of 3 ^{o}C in the winter months to 21 ^{o}C in the summer; in the Payette from an average of 4 ^{o}C in the winter months to 25 ^{o}C in the summer; and in the Weiser from an average of 4 ^{o}C in the winter months to 24 ^{o}C in the summer.

Although there are recorded temperatures that exceed the temperature target in the Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach, there is considerable information available that indicates that water temperatures exceeded the SR-HC TMDL target historically when aquatic species were present in healthy populations. One explanation for this could be a greater occurrence of colder water refugia during periods of high water temperatures in the mainstem. Such refugia would most probably have been present around springs and at the mouth of tributaries in this segment of the SR-HC TMDL reach.

An alternative explanation is that there have always been historical high water temperatures in much of the SR-HC TMDL reach and the lower portions of its tributaries due to high summer air temperatures, high solar radiation, and low summer flows. Native fish species may have adapted to these conditions and are capable of surviving and thriving under temperature conditions with summer water temperatures in excess of those defined by the targets identified in this TMDL.

Available data show exceedences of temperature criteria throughout the SR-HC TMDL reach during the months of June, July, August and September. Cold water aquatic life and salmonid rearing designated beneficial uses are supported in only a limited fashion in the Upstream Snake River segment (RM 409 to 335). Viable populations of mountain whitefish are present in this river segment, rainbow trout and other salmonids are not. Temperature is not judged to be the primary determining factor in the limited support observed within this segment. Lack of cold water refugia and poor water quality are identified as contributing factors.

2.3.1.3 DATA GAPS

See Section 2.4

2.3.1.4 POLLUTANT SOURCES

See Section 2.5. Table 2.5.0 contains a listing of all point sources discharging directly to the mainstem Snake River within the SR-HC TMDL reach.

Point Source Pollution

The majority of permitted point sources discharging to the mainstem Snake River in the SR-HC TMDL reach are located in the Upstream Snake River segment (RM 409 to 335). These include treated municipal sewerage discharges, municipal stormwater discharges and industrial discharges (detailed in Section 2.5.2 and Table 2.5.0). Permitted discharges to the inflowing tributaries also occur. These include treated municipal sewerage discharges, municipal stormwater discharges, agricultural (i.e. confined animal feeding operations) and industrial discharges.

Point sources discharging to tributaries will not receive a separate waste load allocation. Bulk load allocations have been identified for the mouths of the tributaries. The identification of load and waste load allocations specific to the tributary loading will be accomplished through the tributary TMDL process in the case of those tributaries that do not yet have a TMDL in place and as part of the TMDL implementation plan process in the case of tributaries where a TMDL is already in place.

Nonpoint Source Pollution

Nonpoint sources discharging to the mainstem Snake River in the SR-HC TMDL reach include agricultural, recreational, urban/suburban, and forestry land use, as well as ground water and natural and background loading.

Agricultural.

Agricultural land use comprises roughly 25 percent of the total area contained within the SR-HC TMDL reach. Much of this agricultural land, nearly 97 percent, is located in the Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach. Predominant agricultural practices within the drainage of this segment include irrigated and non-irrigated croplands, and irrigated and dryland pasture (grazing). Much of the area is grazed although variations in timing and density of grazed land make exact figures difficult to obtain. The majority of agricultural return flows associated with the SR-HC TMDL reach are also located in the Upstream Snake River segment (RM 409 to 335).

Recreational.

Due to its proximity to populated urban areas and other recreational opportunities within the Hells Canyon Complex, the Upstream Snake River segment (RM 409 to 335) is a major recreational destination site year-round. Water-based recreational activities peak in the summer season with heavy usage observed between Memorial Day weekend and Labor Day weekend, when the river is utilized by boaters, rafters, swimmers, campers, naturalists, hunters and anglers.

Urban/Suburban.

Urban/Suburban land use comprises 0.5 percent of the total direct drainage area of the SR-HC TMDL reach. The majority of urban/suburban land use in the SR-HC TMDL reach is located in the Upstream Snake River segment (RM 409 to 335). Urban/suburban land is present in all tributary and mainstem drainages within the Upstream Snake River segment of the SR-HC TMDL reach. All of the major municipalities within the SR-HC TMDL reach are located in this segment, some discharge directly to the mainstem Snake River, others discharge to inflowing tributaries. All tributary and mainstem drainages in this segment contain septic systems. The highest septic system density in the SR-HC TMDL reach occurs in the Upstream Snake River segment.

Forestry.

Forested land comprises 28.2 percent of the total area contained within the SR-HC TMDL reach. Much of the forested land within the SR-HC TMDL reach is located in the higher elevation portions of the drainage. Silvicultural practices occur or have occurred to some extent within most of this area. However, the majority of water-quality effects from silvicultural practices occur within the drainage areas of tributaries to the SR-HC TMDL reach.

Ground Water.

Many natural springs and ground-water inflows have been identified in the Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach. These inflows occur in all of the tributary drainages and the mainstem Snake River, entering both above and below the water level in many locations. Subsurface recharge to the Snake River system is estimated to be largest in the Upstream Snake River segment due to high irrigation water usage in this area (USBR, 1998). Subsurface recharge from irrigation activities is estimated to dominate over natural ground-water inputs in most areas of this segment.

Background and Natural Contributions.

Natural sources of pollutant loading discussed in section 2.5.3.6 are known to be present in the Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach. While the

Upstream Snake River segment has been substantially altered by the impoundment and diversion of a significant proportion of the upstream drainage, the occurrence of natural sediment transport within this segment is estimated to be greater than in downstream segments due to steep slopes and high elevations in the tributary drainages, and the dominance within the tributary drainages of high velocity, spring runoff flows. The occurrence of natural sources of mercury is more prevalent in tributaries to the Upstream Snake River segment (RM 409 to 335) and the Brownlee Reservoir segment (RM 335 to 285) than in the segments located downstream.

2.3.1.5 POLLUTION CONTROL EFFORTS

See Section 2.6

Nonpoint Source Efforts

Pollutant reduction projects within the watersheds tributary to the Upstream Snake River segment (RM 409 to 335) have been undertaken by a variety of subwatershed work groups outside of the SR-HC TMDL process. Projects have been identified and prioritized in an effort to reduce generation and transport/delivery of pollutants of concern within the tributary watersheds. While the following is not an exhaustive list, individual projects include the following practices:

- canal/ditch delivery upgrades
- field/ditch erosion control measures
- forest practices act measures/practices
- irrigation management upgrades
- irrigation pumpback systems
- river channel/streambank/shoreline erosion controls and restoration
- sediment pond settling and removal of sediments
- stormwater management and treatment
- surface erosion controls
- water conservation measures
- wetland construction/enhancement

Improved grazing, cropping and water management practices have been combined with approved BMP application in the inflowing tributary watersheds and in the mainstem Snake River drainage upstream of this TMDL (upstream of RM 409). Nutrient management plans are in place or in progress in many areas. Several irrigation districts and canal companies in the tributary drainages have made a commitment to meeting water quality standards in irrigation waters discharged to the Snake River. Specific goals have been set to reduce nitrate contamination of ground-water sources, and to reduce sediment, nutrient and bacteria loading to surface water systems through treatment of in-field and end-of-field discharges, and agricultural drains and outflows. Wetland and other treatment systems have been constructed to reduce nutrient loadings and the associated algal growth and decreased dissolved oxygen. Many others are planned. Grazing management programs have been initiated in the inflowing Snake, Boise, Malheur and Payette river watersheds to reduce the negative effects that can be caused by improper grazing management on riparian zones and restore streambank vegetation in an effort to reduce nutrient and sediment loading from pasture lands. Many of these efforts, especially those employed for nutrient and sediment reductions, often require two to five years after completion before they are able to operate at full efficiency. It should be recognized that current data may not reflect the full extent of the water quality improvements that may be realized through these projects. Data collection and evaluation must therefore be an integral part of the overall TMDL assessment process for water quality improvements within the mainstem and/or tributary systems.

Stormwater management plans are in place or pending in the cities of Boise, Ontario and other municipalities that discharge directly or indirectly to the SR-HC TMDL reach. These plans target specific projects and practices to reduce stormwater-based pollutant loads. In several cases substantial progress has been made and positive trends have been documented in overall loading. Septic and wastewater treatment upgrades have been completed, are in progress, or are planned in many areas of the watershed.

Recreational facilities have been upgraded in several areas of the Upstream Snake River segment (RM 409 to 335). Restroom facilities have been improved in high use campground and boat ramp areas and have been installed in other less-used areas that previously did not offer facilities. Pumpout and dump facilities are provided in areas of high use, and public participation in proper disposal of waste materials has increased.

The management practices outlined in the Forest Practices Act (FPA), enforced in both Oregon and Idaho, actively reduce the impact of logging and other use practices in riparian corridors and similarly sensitive areas. Application of these practices on both public and private forested lands has resulted in reduced sediment, nutrient and other pollutant loads being generated and transported within forested systems. Additionally, these practices act to preserve and enhance riparian areas that act as buffers for stream channels in degraded areas, further reducing the potential for pollutant transport to the SR-HC TMDL reach.

Other TMDL Efforts

A matrix containing the reach covered, pollutants listed; state responsible and scheduled completion date for TMDLs in the general area of the SR-HC TMDL reach is included in Section 7.1.

The Mid-Snake TMDL (IDEQ, 1997c) set an in-river target for total phosphorus at 0.075 mg/L, which equates to a 30 percent reduction in total phosphorus loading in the mainstem Mid-Snake system (RM 638.7 to RM 544.7). The Upper-Snake Rock TMDL (IDEQ, 2000d) addresses the same mainstem Snake River segment (RM 638.7 to RM 544.7) but includes tributaries. This TMDL addresses sediment and bacteria concerns in the mainstem and the inflowing tributaries.

There are TMDLs in-place for the North, South and Middle Fork of the Owyhee River in Idaho (IDEQ, 1999c and 2000a). The North Fork Owyhee TMDL set instream targets for temperature to support cold water aquatic life. Additionally, the TMDL addresses the need to meet Oregon State temperature standards at the Idaho/Oregon state line. The data collected for this TMDL do not show impairment from bacteria within the system. The South Fork Owyhee TMDL determined that if water temperatures met Idaho state standards at the Idaho/Nevada border, designated beneficial uses would be supported. This TMDL therefore, requires the State of Nevada to meet Idaho temperature standards at the Idaho/Nevada state line. The data collected for the South Fork Owyhee TMDL do not show impairment from sediment within the system.

The Middle Fork Owyhee TMDL set instream targets for temperature to support cold water aquatic life. The data collected for this TMDL do not show impairment from sediment within the system.

The Lower Boise River TMDL (IDEQ, 1998a) set instream targets for sediment at 50 mg/L for no more than 60 days, and 80 mg/L for no more than 14 days. Targets for bacteria within the Lower Boise River were set as follows: for primary contact recreation (May 1 to September 30) fecal coliform bacteria colonies may not exceed 500 organisms/100 mL at any time; may not exceed 200 organisms/100 mL in more than 10 percent of the total samples taken over a thirty day period; and may not exceed a geometric mean of 50 organisms/100 mL based on a minimum of five samples taken over a thirty day period. For secondary contact recreation (year-round) fecal coliform bacteria colonies may not exceed 800 organisms/100 mL at any time; may not exceed 400 organisms/100 mL in more than 10 percent of the total samples taken over a thirty day period; and may not exceed a geometric mean of 200 organisms/100 mL based on a minimum of five samples taken over a thirty day period. A no-net-increase of instream phosphorus levels was established pending completion of load allocations for the SR-HC TMDL; at which time a nutrient TMDL will be completed for the Lower Boise River to address nutrient targets and bulk load allocations set for the mouth of the Boise River by the SR-HC TMDL.

The Lower Payette River TMDL (IDEQ, 1999b) set instream targets for bacteria (fecal coliform) at less than 50 colony forming units (cfu) per 100 mL. The nutrient TMDL for the Lower Payette River was deferred pending completion of load allocations for the SR-HC TMDL; at which time a nutrient TMDL will be completed for the Lower Payette River to address nutrient targets and bulk load allocations set for the mouth of the Payette River by the SR-HC TMDL.

Agricultural management plans nearing completion for the Malheur watershed (MRBLAC, 2000; MOWC, 1999) have outlined appropriate best management practices for agricultural land use. Measures for the reduction of nutrient loading are detailed, as are mechanisms to reduce erosion and sediment transport from cropping, grazing and irrigation practices.

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